FEBRUARY, 1942

PUBLIC WORKS

Streets and Highways • • • Water Works
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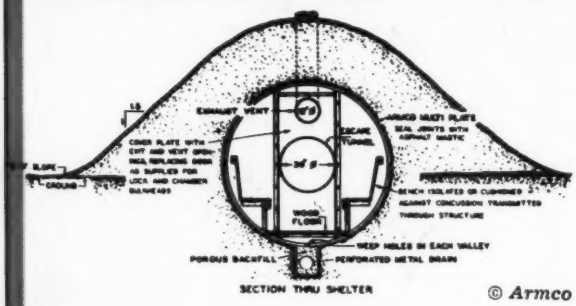

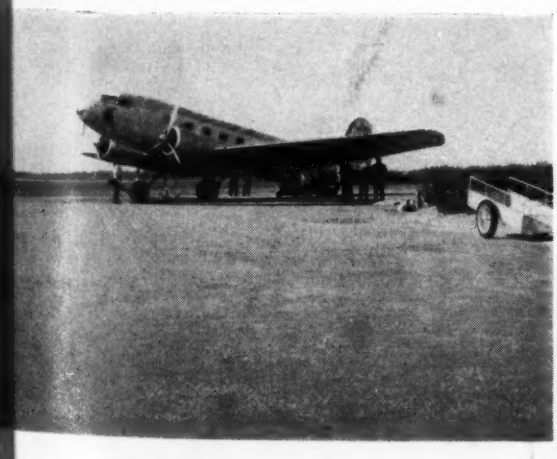

In This Issue:

Protecting and Repairing Municipal Services in War Time

We hope no American cities are bombed, but in case they are, this article tells what to do to protect vital services.

Constructing Air Raid Shelters

Descriptions and illustrations of the types of air raid shelters that have proved most successful in England.

Specifications for Bituminous Surfaces for Highways and Airports

Brief specifications covering the construction of various types of bituminous surfacings.

CEMENT DISPERSION

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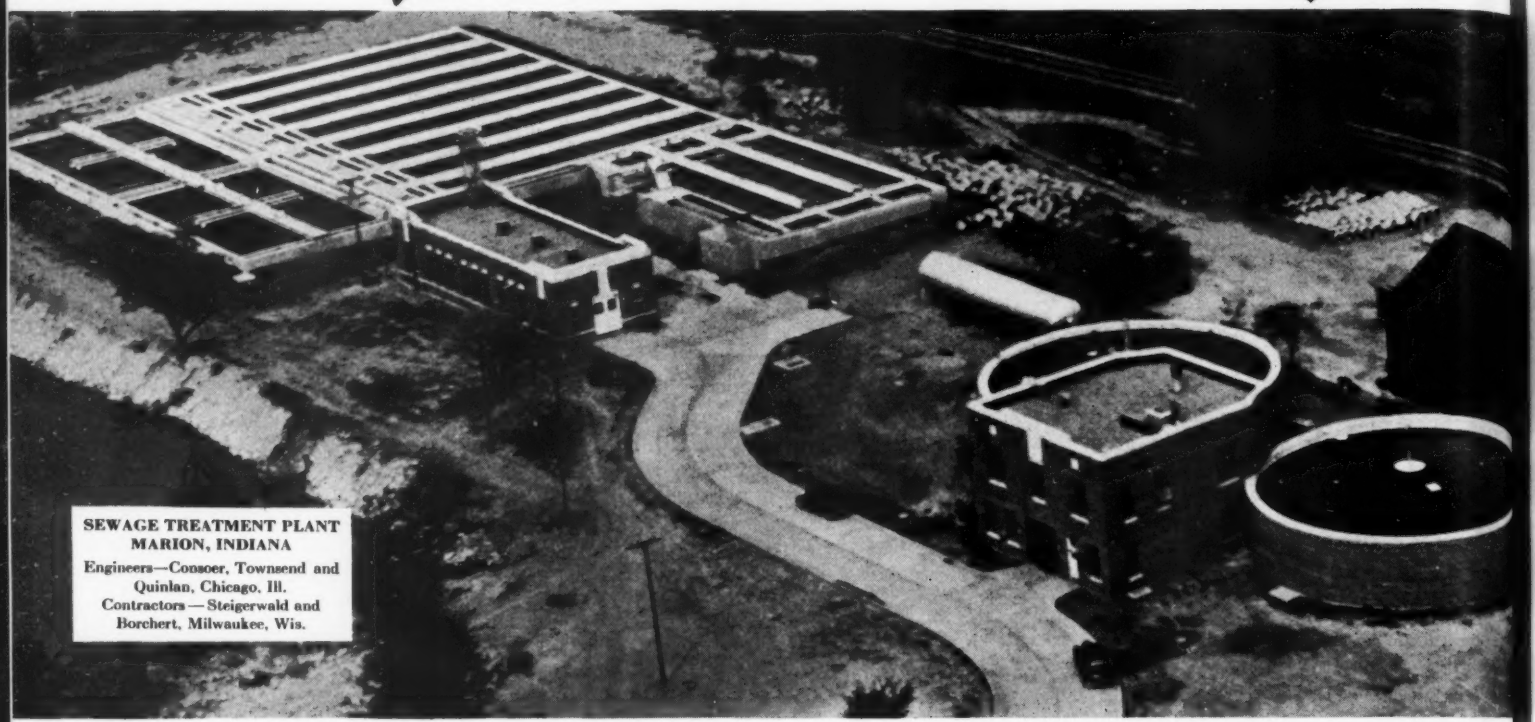

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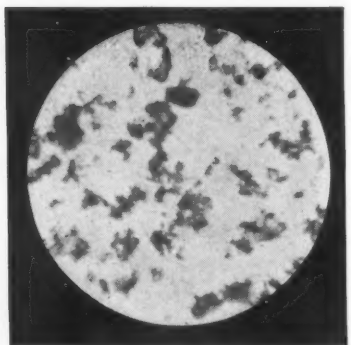

Cement suspended in water
UNDISPERSED

WITHOUT POZZOLITH

In a normal concrete mix, cement particles tend to bunch together, thereby (1) limiting hydration and (2) trapping water within the cement clumps. (See photomicrograph above).

HOW CEMENT DISPERSION WORKS

Only a part of the cementitious value of the cement, whether normal portland or high early, is utilized under usual construction conditions. Investigation shows that with 28 days curing only 50% hydrates. [Anderegg and Hubbell, A. S. T. M. 29 II 554 (1929)].

Dispersed cement produces 25% to 40% higher compressive strengths.

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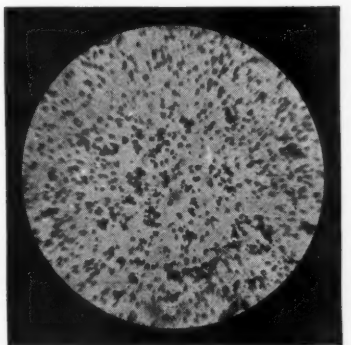

Cement suspended in water
DISPERSED

WITH POZZOLITH

Cement Dispersion drives these particles apart and (1) exposes their entire surface area to hydration, at the same time (2) making the water entrapped in the clumps available for lubrication of the mix. (See photomicrograph above).

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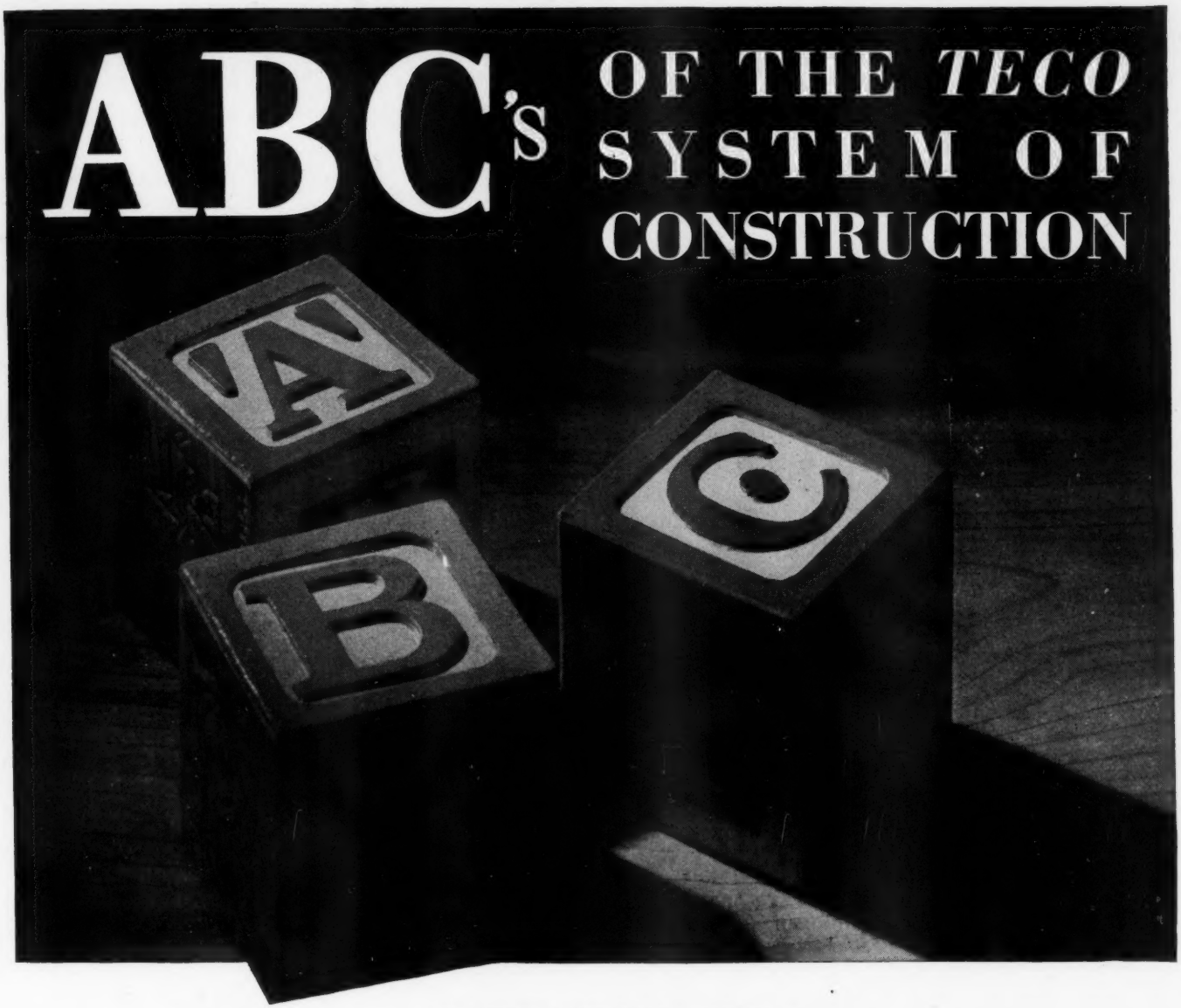

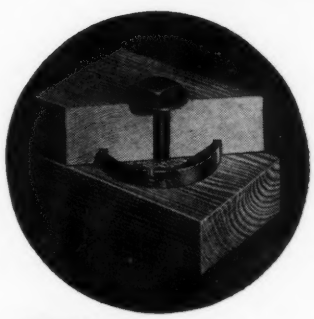

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The Editor's Page

A Poor Place to Practice False Economy

Fifteen months ago when water and sewage installations were being planned for Army camps, an unreasonable economy was insisted on, whenever it could be put across. Plants were pretty generally under-designed, especially as regards capacity, but also in other particulars. This insistence on economy was largely due to the influence of the civilian engineers then employed by the construction agencies of the Army. It was unreasonable from at least two important viewpoints: (1) a plant designed to treat sewage fails to accomplish its purpose if it is either too small or lacks elements necessary to meet local needs of treatment; (2) The money that was thought to be saved was insignificant. A saving of $25,000 on sewage treatment for a $25,000,000 camp is pretty small; also it is small compared to the daily operating cost of such a camp, which is somewhere around $100,000. It would, of course, be fine to save it if the efficiency of the plant were not impaired, but that was rarely the case, as it has turned out.

The argument for economy was based largely on the idea that our camps were temporary. People who never left their desks in Washington thought it was perfectly proper to create a nuisance in some one else's front yard for a "couple of years only." All of this would now be sewage over the weir, so to speak, except for one important fact. More camps are about to be built, and new excuses are being put forward to justify under-design or poor design, such as scarcity of steel or other materials, and the relative economy of having some sickness due to lowering standards—that is, balancing a saving in construction costs against a valuation assigned the health of the troops or of the community.

The consulting engineers responsible for water and sewage installations in the present camps did a grand job whenever they were left alone. When they were cajoled, persuaded or otherwise influenced to lower standards the results were exactly what everyone acquainted with sewage treatment knew they would be. There is no magic touch in sewage treatment or water supply; sound design has no substitute.

Priorities

To many of us during the past several months, priorities have been the most continuous "pain in the neck." Just as we succeed in studying out the probable meaning of a set of priority regulations they were superseded by a different set or modifications and qualifications of the former ones. And now we learn that the OPM, the father of all this confusion, is itself superseded. At this writing, we are informed, authority to operate the priorities system has been vested in James S. Knowlson, as Director of the Division of Industry Operations; and the "Office of Production Management" (OPM) is changed to the "Chairman of the War Production Board" (WPB); and C. H. Matthiessen, Jr. will have charge of the priorities system, with the title of Chief of the Bureau of Priorities.

It might be much worse; all preference rating certificates that were issued by the Division of Priorities of the OPM have been formally validated by Mr. Knowlson.

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Nine steel water tanks on the sites of destroyed buildings in London; for use for fighting fire should the water mains be ruptured.

Protecting and Repairing Municipal Services in War Time

Part II—Protection of Machinery and Instruments

By Joseph D. Lewin and M. J. Popper

IT IS often imperative to protect vital parts of treatment plants from extensive damage. Protection against bomb fragments, flying debris, and glass splinters from windows and skylights will decrease considerably the extent of damage. In England, splinters caused 10 to 20 times more injuries and damage than the direct hits of bombs. It should be kept in mind that, while the blast of a high-explosive bomb will damage everything unprotected within a radius of 30 to 50 feet, the splinters will affect an area of 400 to 700 feet in diameter. The cost of protection against the direct action of an explosive might be prohibitive, whereas the cost of protection against secondary action is generally economically feasible.

Protecting Windows

Glass should be protected against damage due to (a) air pressure or air suction due to blast of explosives, (b) fragmentation, or impact of light incendiaries, (c) vibration of building. Such protection will prevent damage by flying glass to machinery and equipment and to operating personnel, and entrance of poison gases. Many methods and means of protecting glass have been advocated, which fall into four basic groups.

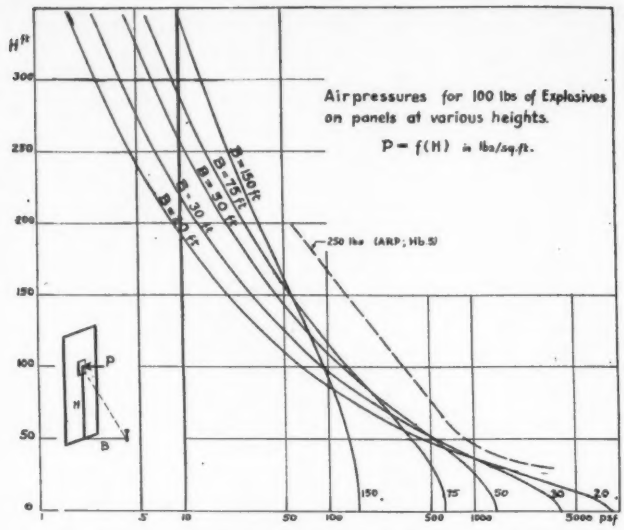


Fig. 3—Pressures developed by 100 lb. of explosive at 20 to 150′ from a wall, and at heights up to 300′ above the ground.

Fig. 4—Window (in England) protected by a wooden enclosure filled with sand and covered with tar paper.

1. Coatings—lacquers, paints, flexible layers (such as tapes, cellophanes, etc.), which are applied to the inner or outer surface of the glass. Their effectiveness is questionable, since the most they can accomplish is to increase the size of glass splinters; and poison gases, if any, would not be prevented from entering the room.

2. Framing of glass, by which a flexible material is inserted between the glass and the frame. This reduces considerably the breakage of glass due to a distant blast and is also effective against vibrations of the building. There is a large variety of such frames, particularly in Germany and Italy. Their effectiveness can be tested by giving a severe blow to the frame. Blast tests conducted in England seem to indicate that small panels resist blast pressure and vibrations better than large panels.

3. Substitution for glass of other materials, such as impregnated cardboards, treated plywoods, composition materials, metals, rubberoids, or plastics. Some plastics are transparent; others are translucent and afford natural lighting in daytime. Glass substitutes are desirable, but the lack of materials might limit their application.

4. Shutters, sheeting, or covering up of glass. This is the most effective method, and for the lower floors often the cheapest. Such protection can be applied from the outside, or inside, or both. The outside protection will preserve the glass from blast pressure, splinters, fragments, anti-aircraft shells, machine-gunning, and even from small incendiaries.

Blast pressures against windows and walls can be calculated. On fig. 3 are plotted pressures developed by 100 lbs. of explosive at given distances from the walls and for given heights of the window panels. For charges other than 100 lbs., the forces will be proportional to $C^{2/3}$, where C is the charge of the explosive in pounds. The vibration period of the glass and wall panels affects the magnitude of the pressure. However, Swiss authorities recommend the use of data on which the curves shown on fig. 3 are based.

Table 4—Minimum thickness of materials for protection against bomb fragments, as recommended by Swiss authorities.

Steel plate	½″-¾″
Reinforced concrete	6″
Mass concrete	8″
Wood	1′-0″
Brickwork	1′-3″
Gravel (sandbags or between boards)	1′-4″
Sand (sandbags or between boards)	1′-8″
Earth (tamped or between boards)	2′-6″

Table 5—Minimum thickness of materials for protection against bomb fragments, as recommended by British authorities.

Mild steel plates	1½″
Solid brickwork or masonry	13½″
Reinforced concrete	12″
Plain concrete	15″
Earth or sand	30″
Ballast, broken stone, gravel	24″

There is a discrepancy between the Swiss (Table 4) and British (Table 5) authorities as to the required thickness of materials to withstand the penetration of fragments. English data are more conservative, but the Swiss are more consistent with respect to values for concrete and are endorsed by the Institution of Structural Engineers, London.

Attention should be paid to the fact that an air space is necessary between the shutters and the glass, to prevent vibrating contact with glass panels. This precaution applies also to inside shutters, to avoid the simultaneous blowing-out of the window and shutter.

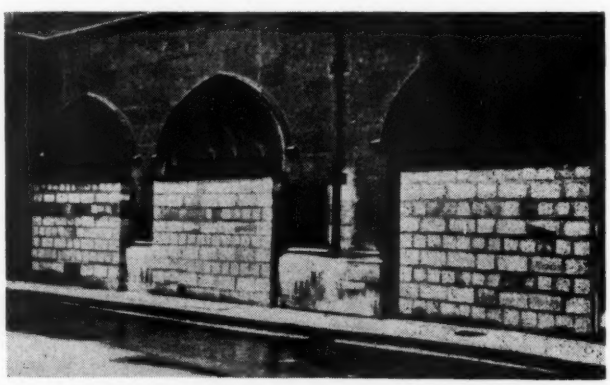


Fig. 5—Brick walls covering windows sufficiently to prevent outside projectiles from injuring occupants. (British)

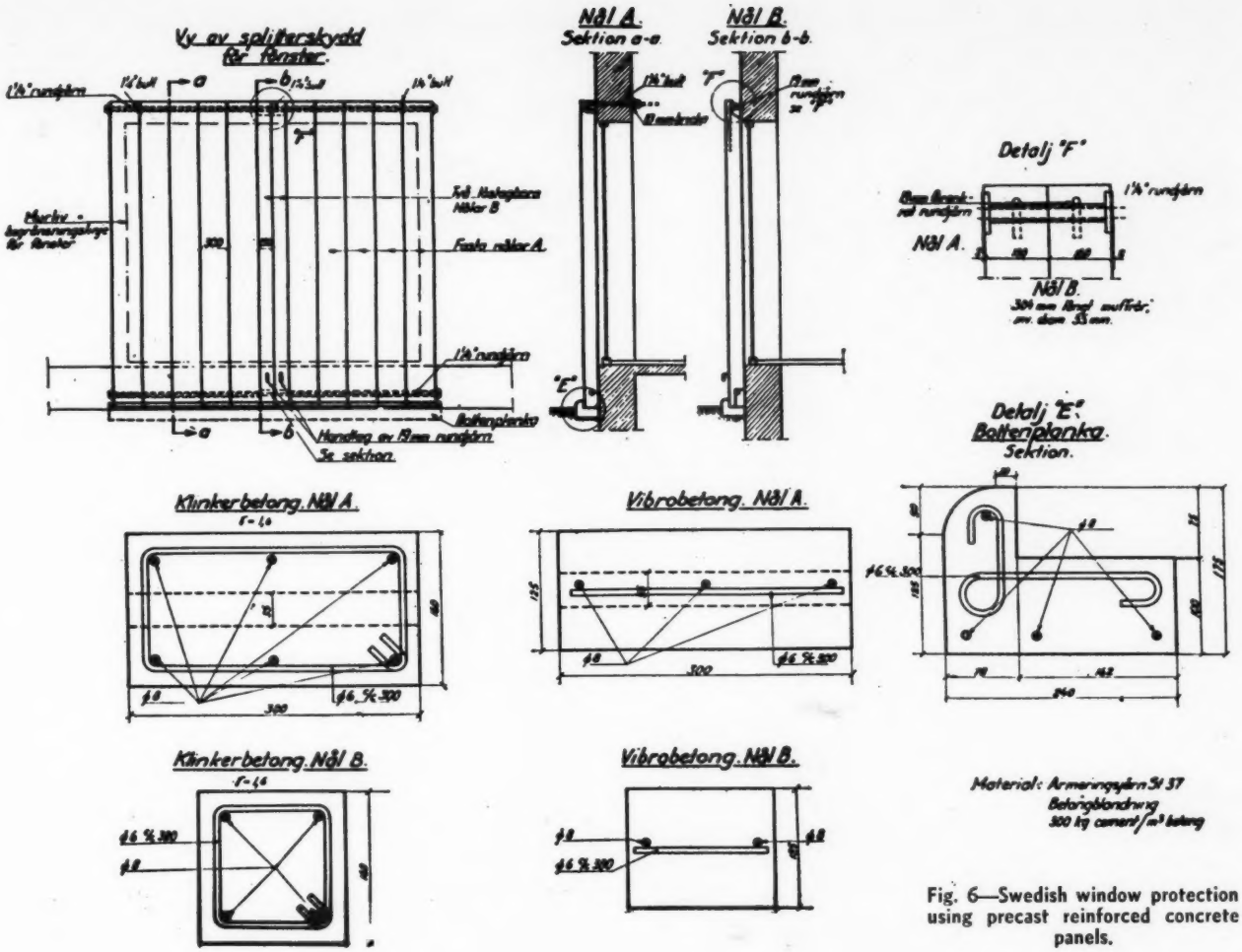


Fig. 6—Swedish window protection using precast reinforced concrete panels.

Windows should be protected at least up to the height of the object which is to be protected.

Since the protection of windows is of paramount importance, several types are discussed in detail.

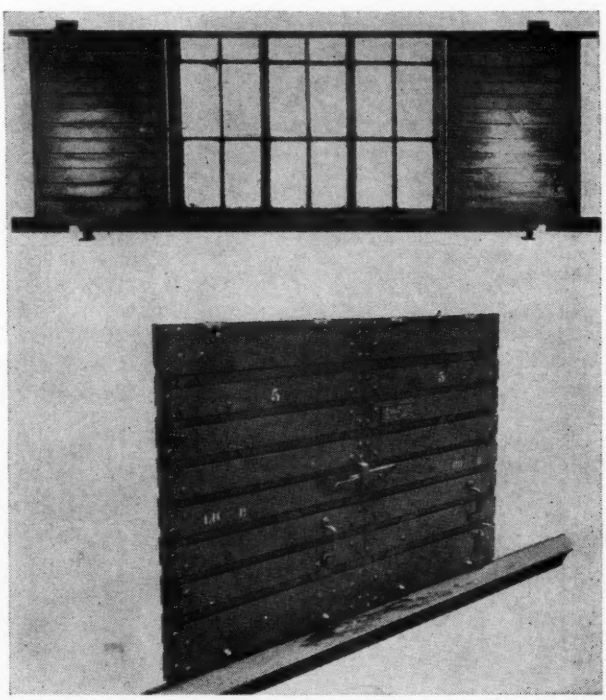


Fig. 7—Laminated steel shutters, sliding on a track, for window protection. (British)

Window protection by a box containing sand is quite simple and effective. However, this particular box is not quite desirable because it does not permit ventilation and, if undrained, is a source of dampness.

In England, brick has been used extensively in preference to concrete. However, it should be kept in mind that British brick is very good and that there is an acute shortage of form-timber for concreting. In this country, concrete or reinforced concrete is preferable. It permits prefabricating and curing of sections which can be placed in front of the windows. Fig. 6 illustrates a shutter used in Sweden. It consists of vibrated reinforced concrete panels 12" wide, 4" thick, reinforced with 5/16" dia. verticals @ 5" and with ¼" dia. horizontals @ 12". The panels are hooked into an upper supporting rod and slid into a bottom reinforced concrete saddle. As many sections as required are bolted together. Because of their weight, and consequent difficulty in handling, such panels may be recommended for ground floor openings.

If steel is available, laminated steel shutters can be used. They permit ventilation. Such shutters can be either sliding or swung on hinges.

Skylights are a constant hazard, because of their vulnerability to even very light fragments or missiles and because of their low resistance to vibration. If possible, skylights should be eliminated. This can be done by replacing glass with structural panels, corrugated sheets, or wooden boards. If the skylight is covered up, glass should not be left in place, but removed, because if the cover is hit, the glass will break and fall, injuring the personnel. If the glass is not removed, a tray should be placed underneath to catch broken glass or fragments.

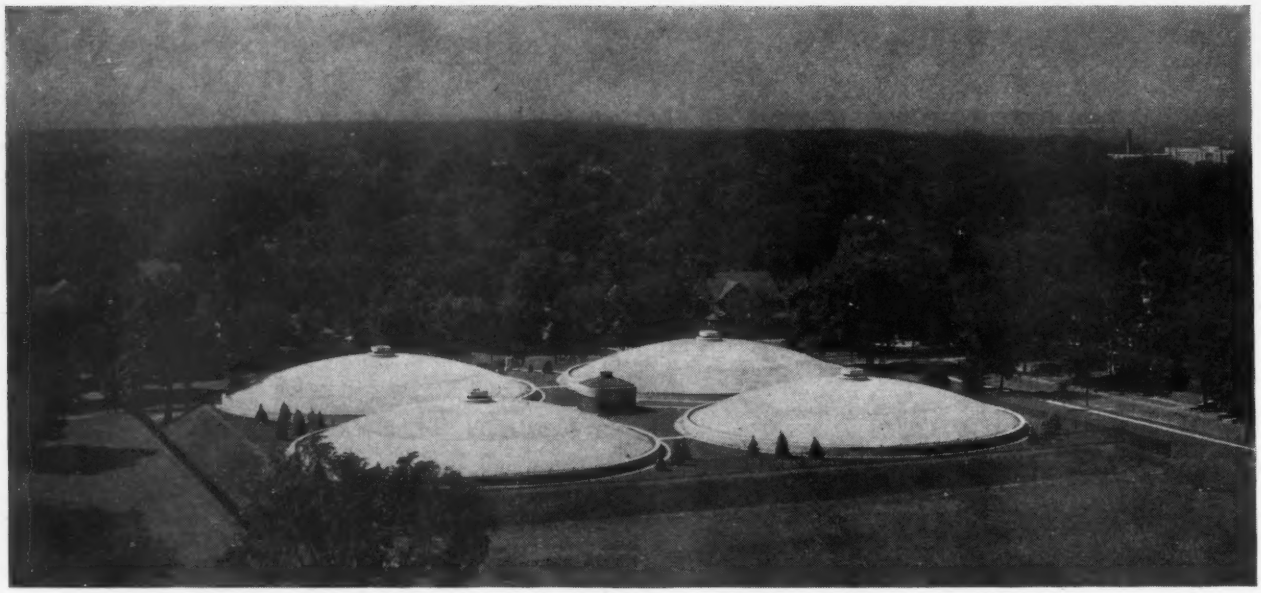


Fig. 8—An artistically pleasing and practically effective arrangement of Hewett tanks; but showing an arrangement not recommended for the future since one blast might cripple the entire water supply.

Various plastic and mastic coverings for skylights are advertised for blackouts. It is important to remember that these materials do not protect the glass, and the blackout requirement is not so important as protection of glass.

To limit the damage from blasts inside the building, blast walls can be placed around important machinery. For thicknesses of the protective enclosures, see Tables 4 and 5. The enclosure should extend above the machine, but not up to the ceiling, lest the expanding gases displace the entire enclosure. A closely woven wire mesh or a matting of woven steel cables has been suggested. The enclosure can be placed on movable frames or suspended.

Duplication and Decentralization

To prevent excessive damage, equipment should be duplicated and, if possible, widely separated. German authorities started duplication years ago. In the design of a large unit, it should be considered how the entire system would function if that unit were damaged. Often, duplication leads also to decentralization.

If all machinery of the same type or all units of the same treating equipment are concentrated in one space, a chance hit or a bomb well placed by a saboteur might destroy all these units and consequently cripple the proper operation of the entire plant. Fig. 8 illustrates a case where "all the eggs were put in one basket"; the appearance and convenience are excellent, but explosion within the area of the four tanks would destroy the pump house and all the tanks.

Decentralization is particularly important in the case of additions to or enlargements of existing plants. Concentrations of new facilities around existing plants attract saboteurs, because of their obviously increased strategic importance.

Decentralization does not merely mean housing two units at the far corners of a yard; they should be separated at least 2000-3000 feet apart, preferably at different parts of a town.

If the functioning of the plant depends on city power supply and alternate power is installed, the new power unit should be placed in a separate building, 400 ft. or more from the plant, and should have at least two separate power connections to it. Portable power units also may be considered.

Plants storing a large amount of liquid chlorine should provide against the danger of simultaneous damage to several tanks. The Russians advocate tank storage outside the building in trenches (weather-protected), or surrounding with earth embankment. If placed unprotected on the surface, they should be 400 ft. apart or more. Storage in cold weather requires special attention. Similar consideration for decentralization should be given to any concentration of supplies, repair parts, materials and spare equipment.

Fig. 9—Blast curtain for window or machinery protection, filled with metal wool or rock wool.

Distribution System

Distribution is the most troublesome part of the water supply system because of the large extent of the piping. Maintenance and repairs may employ a large percentage of the personnel. In England, as much as 40% of the water supply force was diverted for emergency repair.

For rough estimates, it may be recalled that in severe air raids on England, one pipe break per mile of distribution system per attack was not infrequent, and that at least one trunk main per attack may be damaged.

The natural development of a distribution system abroad and in our country has been similar. Fig 10. As the town grew, additional mains were placed. First came some wells and a pump house (20), then a reservoir (1) and a 14″ conduit (2), finally a 1,000,000 gal. elevated storage tank (22) to take care of the peak demand of the growing community. Also interconnections (4) and (17) to the adjacent towns were added. Although this chronological sequence might be justified historically, it is extremely vulnerable in time of emergency. A gridiron type of distribution system is advantageous, provided the mains are sufficiently large to supply additional districts. In Germany, a honeycomb type has been advocated, consisting of diagonal mains, which form a diamond, encompassing the gridiron system.

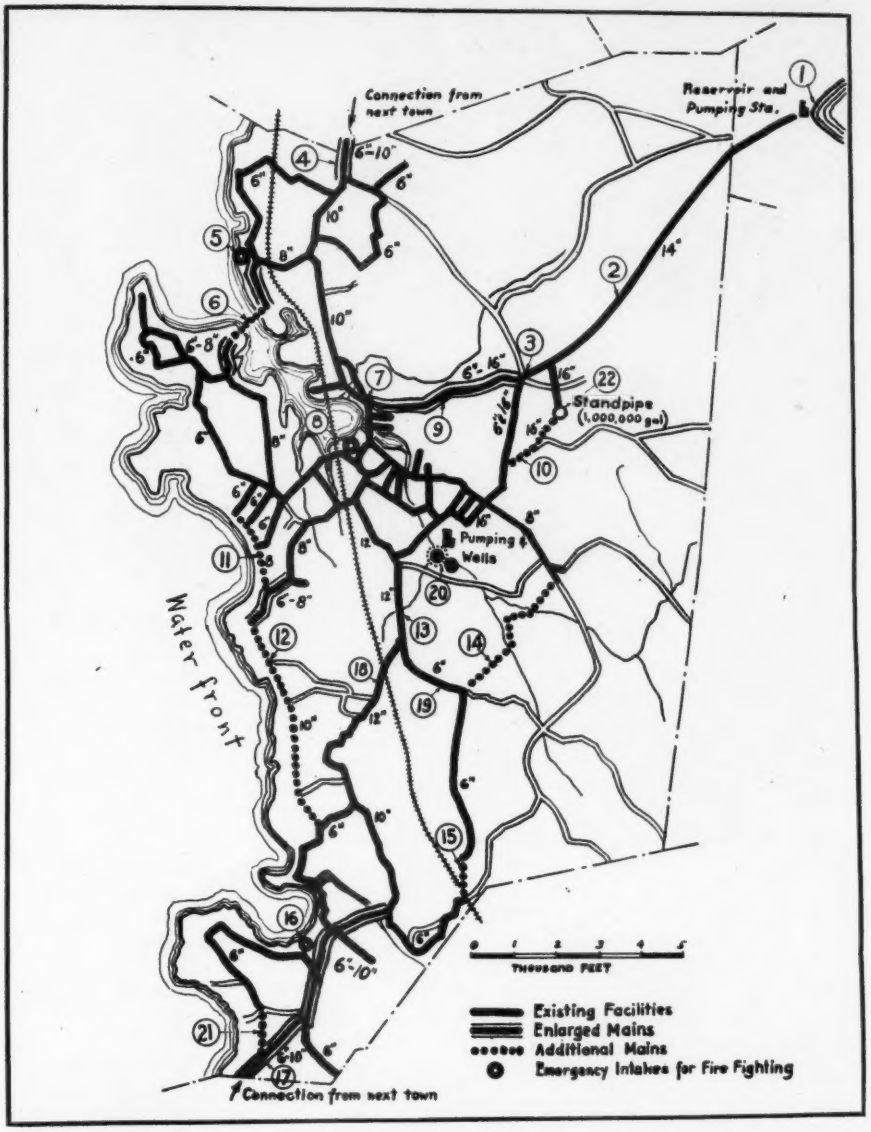


Fig. 10—Suggested improvements for an existing distribution system to enable it to meet emergency conditions.

It is necessary to investigate all the strategically weak points and to prepare a master plan for general improvement. The importance of a particular section might justify immediate installation of such improvement. On the other hand, to reduce the costs, the improvement might be carried out gradually.

An example of such planning is shown on Fig. 10. Any damage at point (3) would isolate the town from the main supply source: the reservoir (1) and the tank (22). To provide a second pipeline for (2) might be too expensive. However, an additional branch (10) to the tank will make its contents available during the repairs on the main line (2).

Fig. 11—Crater that ruptured a water main in Spain.

Fig. 12—Craters in bombed Barcelona.

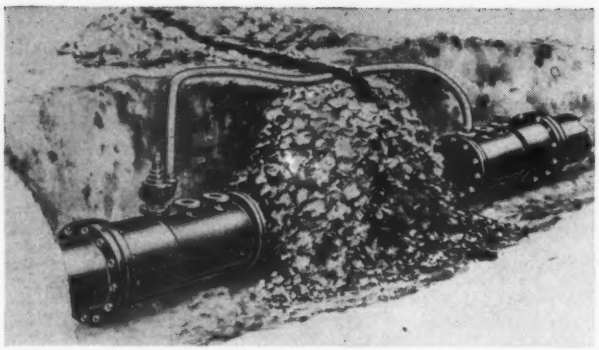


Fig. 13—By-passing break in main by use of "slip-over" fitting connected by hose or flexible pipes. (England)

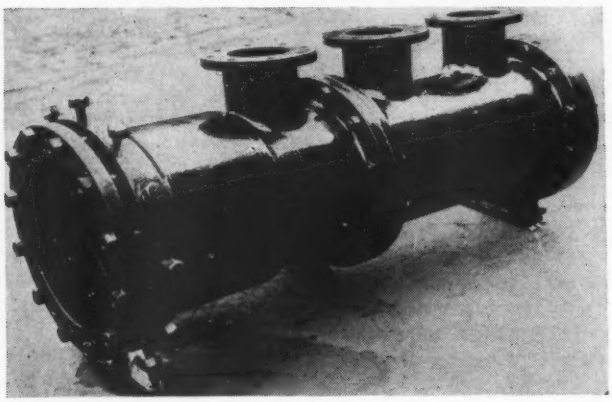


Fig. 14—Slip-over fitting used as shown in Fig. 13.

An act of sabotage or a bomb might damage the pipe (18) and isolate a part of the town; an additional main (15) will produce considerable improvement; likewise for pipe (13) and the additions (12) and (14); or the pipe (7) and addition (6).

The interconnections to adjacent communities (4) and (17) should be increased, so that the town can be supplied entirely by its neighbors. The size of interconnection should be made large, regardless of the supply capacity of the adjacent towns, since this will permit the combined capacity of several towns to be utilized in series. Small towns located between large communities should provide for such transit of water. In England, such provision has proved of inestimable value.

A few emergency intakes (5), (8), and (16) placed at strategic points increase considerably the fire-fighting supply at a small cost. Such intakes should permit operation at low tide or low water, and be free from ice and silt. They may house pumps or have only a connection for a movable pump.

Dual System

In some communities, consideration might be given to a special water system for fire purposes only. Such an installation might reduce considerably the sizes of normal mains, the required storage capacity, and the size of the treating plant for domestic use. Provisions for supplying untreated water for fire are very desirable. Many communities have such fire systems to protect important sections of the city.

Many German towns have avoided placing the two water mains near each other, the high-pressure fire system being placed under the streets and the potable low-pressure system placed between streets under the back yards.

In deciding upon such a dual system, the danger should not be overlooked that untreated water may accidentally enter the domestic supply system. In some communities no cross-connections are permitted, and house connections to fire systems are prohibited in many.

Inventory of Distribution Facilities

For planning any improvement in an existing system, knowledge of the exact location of subsurface distribution facilities is essential. If a community does not have any records of installed piping (as is the case in many old English towns), such pipes should be located and mapped. Such survey should be made well in advance of a possible emergency condition.

To avoid breaking up pavements or excavating to locate pipes, detecting instruments may be resorted to. The importance of a sufficient amount of such instruments in time of emergency cannot be overstressed and a proper stock should be procured before the emergency. Basically these instruments operate on one of two principles. The acoustic instruments pick up the noise of flowing water; the electric instruments record the reflection of an electric impulse. With such pipe detection instruments, the inspection crew can locate the center of a pipe line, its depth under paving, its size, any valves or side branches. The location of valves or cross-connections, the existence of which may have been long forgotten, is of extreme value.

After an inventory has been completed, proper maps should be prepared at least in duplicate to be kept at different places. These maps should be accessible only to very few trusted men.

Sectional maps showing location and sizes of pipes, valves, gates, hydrants, etc., should be prepared for every emergency crew and supervising engineer. Each crew should have the records not only of the section to which it is assigned, but also of the adjacent sections. The crew should be made familiar with the

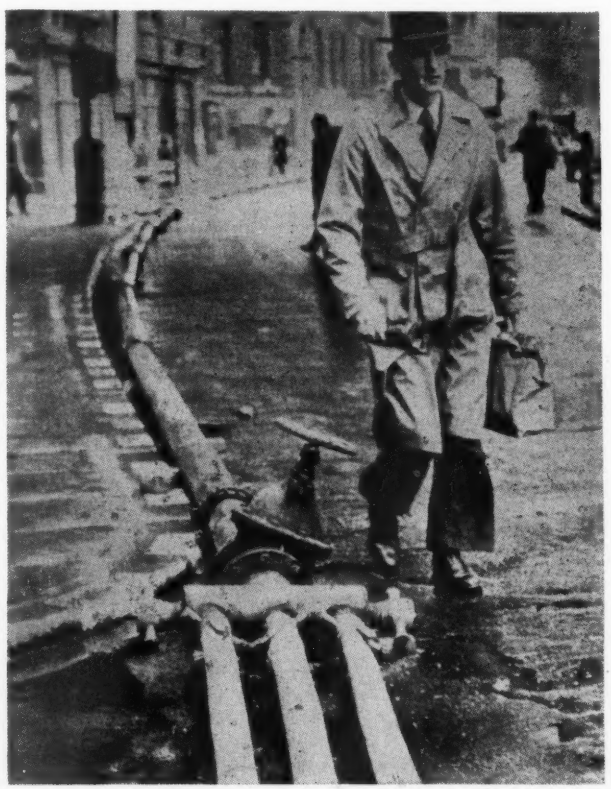


Fig. 15—By-passing a broken main by means of pipe laid in gutter; with header connected to 3 lines of hose.

peculiarities of the adjoining sections so that it might be able to operate also in such sections if the other crew should be overworked or incapacitated.

In analyzing existing systems, and planning for emergency improvements, attention should be paid to the installation of a sufficient number of shut-off valves and gates to insure the isolation of damaged sections. The fact that in England every city block could be shut off independently was of inestimable value.

Emergency Maintenance of Water Supply

As was mentioned before, the distribution system is very vulnerable. Any bomb dropped in the street will break any nearby water pipe and sewer and cause an interruption of water service, with possible pollution. Pipes located 70 to 100 ft. from the bomb are frequently fractured. In clay soil or rock, this distance might be greater, depending on the type of back-fill around the pipe.

Because of conflagrations, the water demand is at its maximum during a bombing and water losses or drop in pressure must be kept at the least possible. Collapsing structures may bury some of the valves, and make them inaccessible. The desirability of having a liberal number of valves, or even automatic valves, is self-evident. To limit the variety of valve sizes to be kept in stock, pipe reducers can be used. Standardization on a few valve sizes will make them more procurable during the emergency and interchangeable with adjacent communities.

It must be borne in mind that the amount of debris in a bombed area is so enormous that, even after the cleaning up of the roadways, the sidewalks are covered with it. This condition warrants an increased number of hydrants.

In many cases, the access to broken pipes is very difficult. In addition to the debris blocking the roads, the bomb craters make the streets difficult for travel by repair trucks, particularly during night-time raids. Some of the emergency repair equipment is liable to be damaged by accidentally falling into bomb craters, or by explosives; hence sufficient reserves should be on hand.

Emergency repair equipment should be sturdy and sufficiently mobile for moving over debris. Two-wheel trailers are very useful for such emergency work. Every unit should be equipped for self sufficiency and be able to perform all types of repair under any conditions, including a blackout.

The emergency repair equipment should be decentralized as much as possible, so that the distances from

Fig. 17—Split coupling clamp (Skinner) for repairing broken mains.

Fig. 16—For repairing a leaking bell-and-spigot joint. (Skinner)

points of repair to the nearest emergency station shall be small. Since telephone communication may be interrupted, two-way or "talky-walky" wireless equipment may be resorted to for ensuring uninterrupted contact with crews.

In deciding upon location of emergency stations, the possibility of exits being blocked by debris should not be overlooked. Stations with two independent exits on two streets are preferable. Low, one-story frame buildings such as garages are good for such purposes. If they are opposite or adjoining tall brick buildings, the debris from these, if wrecked, may block the exits or even crush the small frame structure; therefore locations on wide streets, squares, parks or wide yards are desirable.

Similar considerations govern buildings for storage of repair equipment and repair parts.

Training trusted residents and acquainting them with the location and operation of shut-off valves and furnishing them with wrenches for the same may be desirable in some localities.

Emergency Repair

Emergency repairs may be of temporary or of permanent nature. The question of time, availability of materials and labor, and the probable duration of the emergency might influence the decision. Despite the repeated bombings, London decided on making permanent repairs promptly after the damage occurred. It appears that the same policy may be accepted here, since the possibility of enemy bombing on a scale commensurate with London is questionable. English authorities consider that the peace-time methods of repairing water mains involving the use of lead, poured and caulked, or formed with lead wool packing, require skilled labor and tedious operation and therefore other and faster methods should be resorted to. The method to be applied should be left to the discretion of the engineer in charge. It is also evident that not all methods are applicable to every case; high pressure pipes, for example, present special conditions.

Germany developed two alternate methods of joint packings; one consists of plastic iron impregnated with bitumen, the other of aluminum wool or aluminum foil.

In general, mechanical methods and plastic jointing materials are preferable, not only because of the speed and the ease of installation, but also because of their resistance to shock-vibrations and to settlements of back-filled craters. Mechanical methods use

Fig. 18—LeTourneau portable bridge can be used for carrying vehicular traffic over holes, debris, etc.

a rubber ring which is compressed either (a) in a space between the bell and socket by means of screws or (b) below a collar slipped over the junction of two plain ends of pipes.

Plenty of repair sleeves should be kept on hand for all sizes of pipe used in the distribution system for repairing cracks, breaks or leaking joints. These are obtainable from a number of firms. The installation of a repair sleeve takes from a few minutes for 12″ pipe to about 25 minutes for 72″ pipe.

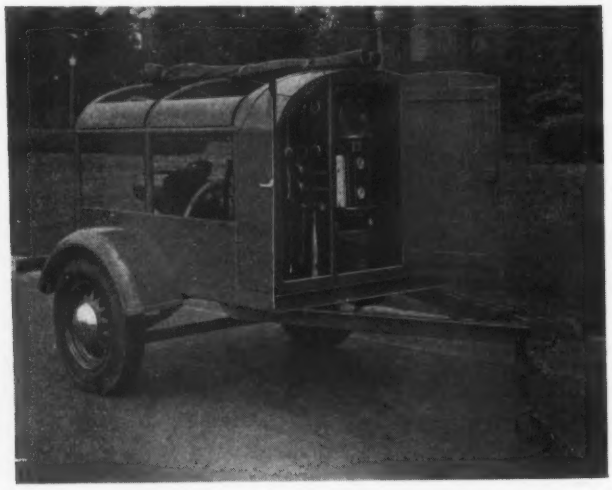
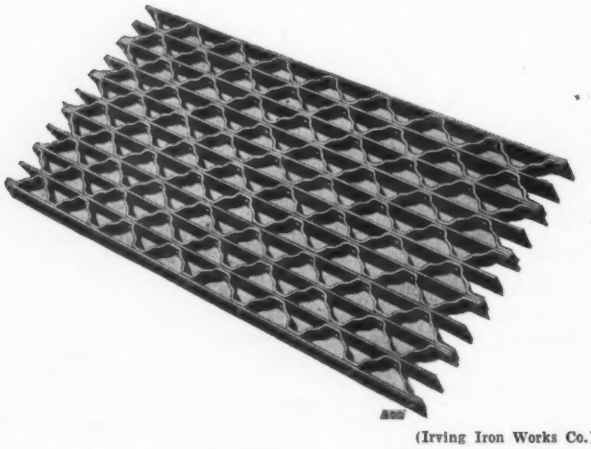


Fig. 19—Wallace & Tiernan trailer-type mobile chlorinator.



(Irving Iron Works Co.)

Fig. 20—Sectional steel grating can be used for carrying foot traffic over craters or other cavities.

It is important that any pipe repair part fulfill three requirements: (a) Flexibility, sufficient to resist settlement without leakage. (b) Speedy installation, if possible with semi-skilled forces. (c) Possible use when the pipe is not "dry," in undrained craters, without additional excavation, and under other very unfavorable working conditions.

If the shut-off valves are spaced at long intervals, damage to a pipe may require putting a considerable stretch of main out of service and bypassing it by means of surface pipe; but bypasses should be temporary, since they are a nuisance to traffic, bothersome at street intersections, during cold weather, etc.

For quick repair of pipe it is often necessary to clear away the debris. Speedy small graders or shovels can hasten the clearing up considerably, and help in backfilling the craters.

Repair of large mains may require considerable time, and consideration should be given to methods for maintaining street traffic while repairs are in progress below the surface. Ready-made covers for craters are very useful. Grating panels as developed for covering craters on airfields may be applicable for streets also. Spanning of larger craters by portable bridges can also be resorted to.

Not only the visible damages to pipe need to be repaired. Every bomb falling on the street produces, in addition to direct damage, a blast vibration which may cause a break in a main 30 to 200 ft. from the center of the crater. A consequent leak might go unnoticed if water is seeping directly into a sewer. The importance of discovering and repairing such leaks is evident, and a bombed area should be surveyed for fractured mains as soon as possible. An adequate number of leak-detectors is needed for this work.

In backfilling, use of a concrete saddle in rocky ground will aggravate the conditions; the pipe should rather be placed on a sand or gravel layer, and backfilled with a loose material.

(Continued on page 41)

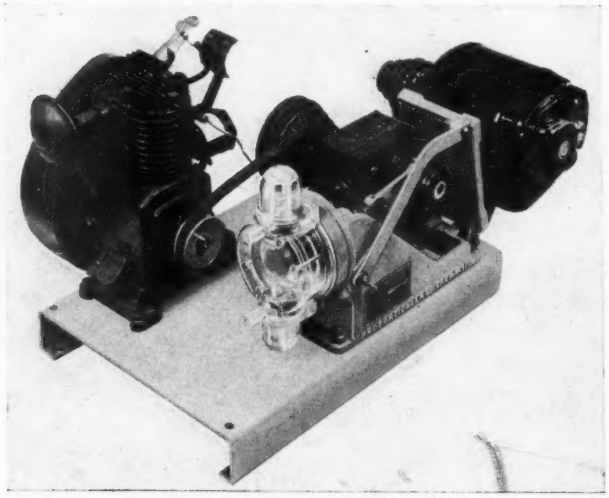


Fig. 21—%Proportioneers% Midget Chlor-O-Feeder, for proportional feeding of chlorine.

Spreading fine aggregate on Tarmac seal coat

Specifications for Bituminous Surfaces for Highways and Airport Runways

Last year 755 County Engineers told us what kind of articles they wanted us to publish. 418 or 55% gave the subject of this article as their first choice. The material prepared by the editors of PUBLIC WORKS will be published in three installments, of which this is the first.

IT is the intention to present herein brief specifications covering the construction of various types of bituminous surfacings. The methods of such construction have become standardized, and it is not often necessary to modify them materially to meet local conditions. Through such standardization, based on research and experience, the element of chance has been removed, and good construction can be assured. The specifications, as given, can be modified as desired, in accordance with a sound knowledge of local conditions.

A. Materials Specifications

1. *Aggregates.*—a. The coarse aggregate shall consist of crushed stone, or of screened gravel; in either case, composed of sound, tough, durable fragments or pebbles, and screened to the sizes required. (Table 1 shows sizes recommended by the Asphalt Institute and Table 2 the gradations recommended by the Koppers Co.). The aggregate shall show a per cent of wear of not more than 40 using the AASHO method T-96. All aggregate shall be reasonably free from flat, elongated, soft or disintegrated pieces, clay balls and similar matter.

b. Sand shall be composed of washed, clean, hard, durable, uncoated particles, well graded from coarse to fine, and shall be free from lumps of clay and all organic matter.

c. Further details in regard to aggregate gradings will be given under the paragraphs covering the various types of surfaces.

2. *Bituminous Materials.* — General specifications have been prepared, standardizing both tars and asphalts. Table 3 presents a summary of specifications covering the 14 standard types of road tars. Asphalts are divided into SC (slow-curing), MC (medium-curing) and RC (rapid-curing). Specifications for these are shown in Tables 4, 5, and 6. Table 7 shows the specifications for emulsified asphalts. Reference to these materials in specifications may be by the designations shown, or by listing the requirements, or by both.

3. *Prepared Paving Mixtures.*—There are several excellent and highly satisfactory prepared or proprietary paving mixtures which are adapted for various types of work. Specifications for these materials will be given later in this article.

Mineral Aggregates*

AGGREGATE GRADINGS FOR SURFACE TREATMENTS

As shaker screens are rapidly replacing circular ones, aggregates are being specified as percentages passing square openings instead of round openings. The following table shows sizes of round openings and approximately equivalent square openings.

Square Openings	*Round Openings*	*Square Openings*	*Round Openings*
No. 8	1/8"	1 1/4"	1 1/2"
No. 4	1/4"	1 1/2"	1 3/4"
3/8"	1/2"	1 3/4"	2"
1/2"	5/8"	2"	2 3/8"
5/8"	3/4"	2 1/4"	2 3/4"
3/4"	7/8"	2 1/2"	3"
7/8"	1"	3"	3 1/2"
1"	1 1/4"	3 1/2"	4 1/4"
1 1/8"	1 3/8"	4"	4 3/4"

Note	% Passing Screen						Sieve	
	1 1/2"	1 1/4"	1"	1/2"	1/2"	1/4"	10	200
a.	100	90+	90+	25–75	—	10—	—	—
b.	—	100	—	—	10—	—	—	—
c.	—	—	—	100	75+	—	—	10—
d.	—	—	—	100	95+	10—	—	—
e.	—	—	—	—	100	95+	15—	—

a. Stone or slag with .4-.5 gal. per sq. yd. asphalt cement.—67
b. Stone or slag with .2-.3 gal. per sq. yd. asphalt cement—6.
c. Stone, slag or gravel with .25-.4 gal. per sq. yd. M.C. cut-back.—7
d. Stone or slag with .15-.4 gal. per sq. yd. R.C. cut-back.—79.
e. Stone, slag or sand with .1 gal. or less R.C. cut-back.—9.

AGGREGATE GRADINGS FOR ROAD MIX

a. Macadam Aggregate Type

	% Passing Screen				
	1 1/2"	1"	3/4"	3/8"	1/4"
Coarse—5	95–100	25–75	—	0–10	—
Fine —4	—	—	95–100	—	0–10

Stone, slag or gravel with at least 60% crushed angular particles for material retained on 1/4"

b. Graded Aggregate Type

	% Passing Screen			Sieve	
	1 1/2"	1"	1/4"	10	200
Open Graded	100	75–95	40–60	30–45	0–5
Dense Graded	100	90–100	50–70	35–60	5–14
Alternate*		100			10–20

Stone, slag, gravel, sand with or without mineral filler added.

Portion passing 40 mesh:

Field Moisture Equivalent (81) not more than 20%
Linear Shrinkage (82) not more than 3%

BROKEN STONE OR SLAG GRADINGS FOR ASPHALT MACADAM

Note	% Passing Screen						
	3 1/2"	2 1/2"	2"	1 1/2"	3/4"	1/2"	1/4"
a.	95–100	0–15	—	—	—	—	—
b.	—	95–100	25–75	0–5	—	—	—
c.	—	—	—	—	95–100	25–75	0–5

a. For use only in base course if 3 1/2" or more thick.—1.
b. Coarse aggregate for base and surface course.—3.
c. Fine aggregate for base and surface course.—67.

Note.—In base construction crushed gravel may be used if produced only from that portion of the gravel retained on a 3 1/2" screen.

AGGREGATE GRADINGS FOR HOT-MIX ASPHALTIC CONCRETE*

a. Coarse Aggregates—Broken stone, slag or gravel

Screen	Alternates for Base		Alternates for Surface Course	
	% Passing A	% Passing B	% Passing A	% Passing B
2 1/2"	100	—	—	—
2 1/2"	95+	—	—	—
1 3/4"	—	100	—	—
1 1/2"	—	95+	100	—
1 1/4"	60–75	—	95+	—
1"	—	—	—	100
3/4"	30+	40–75	40–75	95+
1/2"	—	—	—	40–75
1/4"	—	1—	1—	15–30
10 Sieve	—	—	—	1—
	(3)	(57)*	(3)	(79)

b. Fine Aggregate—Sand

	Per cent
Pass. 1/4" Screen	98–100
" 1/4" " ret. 10 Sieve	8–25
" 10 ret. 40	15–50
" 40 " 80	22–65
" 80 " 200	7–40
" 200	0–8

c. Mineral Filler—Dry limestone or other approved mineral dust used only in surface course.

	Per cent
Pass. 30 Sieve	100
" 100 "	85+
" 200 "	65+

AGGREGATE GRADINGS FOR STONE-FILLED SHEET ASPHALT*

a. Coarse Aggregate—Preferably broken stone or slag, alternate gravel (8).

	Per cent
Pass. 3/4" Screen	100
" 5/8" "	95+
" 1/4" "	75—

b. Fine Aggregate—Sand

	Per cent	
Pass. 10 Sieve	98–100	
" 10 ret. 20	3–15	14–50
" 20 " 30	4–15	
" 30 " 40	5–25	
" 40 " 50	5–30	30–60
" 50 " 80	5–40	
" 80 " 100	6–25	15–40
" 100 " 200	6–25	
" 200	0–5	
" 200 as delivered to mixer	0–3	

AGGREGATE GRADINGS FOR SHEET ASPHALT*

a. Binder Course — Coarse aggregate — Preferably broken stone, alternates slag or gravel (57).

	Per cent
Pass. 1 1/2" Screen	100
" 1 1/4" "	95+
" 1/2" ret. on 1/4"	15–35
" 1/4" " " 10 Sieve	10–25
" 10	5—

Fine aggregate—Sand all passing 1/4", no grading requirements.

AGGREGATE GRADINGS FOR COLD-PATCH MIX

(Stone, Slag or Gravel)

Depth Patch	% Passing Screen				
	2"	1 1/4"	3/4"	1/2"	1/4"
1 1/2"+(337)	100	40–75	25–40	—	0–5
1 1/2"—(57)	—	100	95–100	40–75	0–5

Note.—To be used with from 4 to 5 1/2% by weight of R.C. cut-back.

GENERAL REQUIREMENTS FOR BROKEN STONE

	ALTERNATES	
	Deval	*Los Angeles*
% wear for base or binder courses	8—	50—
% wear for surface courses	6—	40—

Reasonably uniform in quality, clean and free from an excess of dust, and flat or elongated particles

GENERAL REQUIREMENT FOR BROKEN SLAG

Slag shall weigh not less than 70 pounds per cubic foot for each commercial size used.

GENERAL REQUIREMENT FOR SAND

Sand shall be composed of clean, tough, rough surfaced grains, free from clay, loam and other foreign matter. For hot-mix construction it shall be free from clayey lumps or loosely bonded aggregations as delivered to the mixer.

B. General Items

1. *Equipment.*—a. All equipment used in the work must be approved by the Engineer and shall be maintained in satisfactory working condition. The Contractor shall provide sufficient equipment to perform the various required operations in the proper sequence and at the proper time and speed.

b. Hauling equipment shall consist of pneumatic-tired vehicles equipped with dump bodies suitable for dumping the material into spreader boxes or in a uniform windrow, as directed by the engineer.

c. Distributors must be capable of applying the material on the surface of the road at the rate specified or ordered by the Engineer. The pressure shall be equal throughout the full length of the spray bar, and the specified rate must be maintained during the application of the entire load, regardless of change in gradient or direction. The distributor shall be equipped with a suitable thermometer to show at all times the temperature of the contents. It shall be equipped with a manifold connection to which a hose may be attached for single-nozzle hand spraying of areas not properly covered.

d. Rollers shall be in first class mechanical condition, free from back-lash, loose link motion, faulty or loose-steering mechanism, worn king bolts and bearings. They shall be capable of being reversed smoothly. Rollers shall comply with weight requirements as indicated in the sections relating to the different types of surfaces. All rollers shall be marked permanently and legibly to show the manufacturer's net operating weight as distributed on each axle.

e. Specific items of other equipment may be added when the character of the work requires. In general, specifications should cover size or capacity, operating condition, and ability to meet special requirements, such as heat production, accuracy and similar factors.

2. *Provision for Traffic.*—Traffic must be safeguarded at all times by the contractor, who will furnish and maintain satisfactory warning signs, barricades, lights and watchmen. Courtesy must be shown to the traveling public. When a detour is not provided, the work shall be arranged so that traffic may pass at all times, with a delay at no time exceeding 5 minutes.

3. *Sanitation.* — The contractor shall provide and maintain in a sanitary conditon such accommodations for the use of his employees and of the engineer's staff as are required by the Local or State Health Department.

4. *Other Items.*—If desirable or necessary, usual provisions may be inserted regarding observance of local and state laws; permits and licenses; patented or proprietary materials; the use of explosives; preservation and restoration of property, trees and monuments; respon-

Table 1. The Asphalt Institute's recommendations for aggregates —Below: Table 2.

CRUSHED AGGREGATE GRADATIONS AND THEIR USES IN TARMAC CONSTRUCTION

Aggregate Size		Gradation—Percent Passing Sieves (Square Openings) by Weight												
Nominal Size Square Openings	Approx. Size Round Openings	4"	3 1/2"	2 1/2"	2"	1 1/2"	1"	3/4"	1/2"	3/8"	No. 4	No. 8	No. 100	USES
2"–3 1/2"	2 1/2"–4 1/4"	100	90–100		0–15									Broken Stone Base Course
1"–2"	1 1/4"–2 1/2"			100	90–100	35–70	0–15							Penetration macadam-wearing course
No. 4–1"	1/4"–1 1/4"					100	90–100	40–75	5–20		0–5			Mixed-in-Place Construction
No. 8–3/4"	1/4"– 3/4"						100	90–100		30–65	5–25	0–5		Cover material for Double (Cold and Hot) Surface Treatment
No. 8–1/2"	1/4"– 1/2"							100	90–100	40–70	5–25	0–5		Drag leveling course, choke for penetration macadam, cover material for hot surface treatment over cement-concrete and brick
No. 8–1/4"	1/4"– 1/2"								100	90–100	10–30	0–5		Seal coats for Penetration Macadam, Mixed-in-Place and Drag Leveling Course. Cover material for cold surface treatment.
0–No. 4	0–1/4"									100	85–100		10–30	Screenings for Broken Stone.. Base Course

Abbreviations and gradations of aggregate, are included in the U. S. Department of Commerce, National Bureau of Standards, Simplified Practice Recommendation R 165-41.

sibility for damages and damage claims; bonds, and similar items.

C. Preparation for Surfacing

1. *Preparatory Work.*—If the surface is to be placed on a wholly new road, necessary drainage, both surface and subsurface, should be provided for in the construction contract. It will be the more general case, with the surfaces considered in this article, that the work will be on an existing road.

The work to be done will include patching of the deeper holes (those over ¾ inch deep); scarifying to remove bumps and wavy areas; compacting where indicated; treatment by scarifying, shaping and rolling of loosely bonded areas; and the general work needed to provide a surface that is properly crowned, of the required width, uniform, firm and provided with adequate drainage, both surface and subsurface.

This work is normally done well in advance by force account, and will therefore not be a contract item. Experience has shown that this is the best method of handling such work.

2. *Final Preparation of the Subgrade.*—All soft materials or portions of the subgrade which will not compact readily shall be removed as directed by the engineer, and all loose rock and boulders shall be removed or broken off to a depth not less than 6 inches below the surface of the subgrade. All holes or depressions made by the removal of such material shall be filled with approved material. The whole subgrade shall be brought to line, grade and cross-section, and to a uniform condition of compaction and supporting power. The material required for this shall be obtained as excavation or borrow and paid for as such.

3. *Where The Subgrade Has Previously Been Constructed.*—The subgrade shall be restored by removing all vegetation, filling all settlements, smoothing, excavating, removing all material above the required elevation, and shaping and compacting to the required grade and cross-section. The Contractor shall maintain the subgrade to the specified section, free from ruts, waves, and undulations during surfacing. Provision must be made for positive surface drainage of the subgrade.

4. *Shoulders.*—The shoulders include that portion of the roadbed not covered by gutters, surface course or pavement, and including berms back of curbs and gutters. The work to be done on them must be clearly defined; it usually will include trimming and shaping by a blade grader, supplemented by necessary hand work to produce smooth surfaces and slopes and uniform cross-sections.

5. *Finishing.*—The slopes of embankments, excavations, borrow pits and roadside pits shall be trimmed and finished to the lines and grades shown in the plans or designated by the engineer. Ditches and channels shall be cleared of debris and obstructions and cut true to line and grade. Excess earth and debris shall be removed and the right-of-way left in an orderly condition. Burning of logs and brush on the right-of-way will be permitted only with the approval of the engineer. All backslopes, even though they are beyond the limits of excavation shown in the plans, shall be trimmed and finished as directed by the engineer.

6. *Payment.*—(1) Work done under Par. C 2, above, is usually paid for on either a square yard or a per mile basis. Specifications must be expanded to show clearly what is to be done. (2) Under Par. C 2, 3, 4 and 5 the work is not usually paid for, but is considered as necessary subsidiary work pertaining to surfacing, for which direct payment is made.

7. *Subgrade Treatment.*—a. General. This consists of incorporating a stabilizing course of specially approved and selected material into the completed subgrade to improve the foundation. It shall include all necessary plowing, disking, harrowing, mixing, watering, shaping and rolling.

b. Materials. — The stabilizing materials shall consist of fine gravel, stone or slag screenings, coarse sand, topsoil, cinders or other granular materials,

GRADES	RT-1	RT-2	RT-3	RT-4	RT-5	RT-6	RT-7	RT-8	RT-9	RT-10	RT-11	RT-12	TCB-5	TCB-6
Consistency:														
Saybolt Sp. Vis., @ 40°C.	5-8	6-11	11-22	22-45										
Saybolt Sp. Vis., @ 50°C.					17-26	26-40							17-26	26-40
Float Test @ 32°C. Seconds							50-80	80-120	120-200					
Float Test @ 50°C. Seconds										75-100	100-150	150-220		
Sp. Gr. @ 25°C. /25°C.	1.09+	1.09+	1.09+	1.09+	1.10+	1.10+	1.12+	1.11+	1.11+	1.15+	1.16+	1.16+	1.09+	1.09+
Total Bitumen, % by wt.	88+	88+	88+	88+	85+	85+	78+	78+	78+	75+	75+	75+	80+	80+
Water, % by volume	2.0 -	2.0 -	2.0 -	2.0 -	1.5 -	1.5 -	1.0 -	0	0	0	0	0	1.0 -	1.0 -
Distillation, % by wt.:														
To 170°C.	7.0 -	7.0 -	7.0 -	5.0 -	5.0 -	5.0 -	3.0 -	1.0 -	1.0 -	1.0 -	1.0 -	1.0 -	1.0-8.0	1.0-8.0
To 200°C.													5.0 +	5.0 +
To 235°C.													8.0-18.0	8.0-18.0
To 270°C.	35.0 -	35.0 -	30.0 -	30.0 -	25.0 -	25.0 -	20.0 -	15.0 -	15.0 -	10.0 -	10.0 -	10.0 -		
To 300°C.	45.0 -	45.0 -	40.0 -	40.0 -	35.0 -	35.0 -	30.0 -	25.0 -	25.0 -	20.0 -	20.0 -	20.0 -	35.0 -	35.0 -
Softening Point of Distillation Residue, R & B, °C.	50-60	50-60	55-60	55-65	55-70	55-70	55-70	55-70	55-70	40-70	40-70	40-70	40-70	40-70
Application Temperatures	60° to 125°F.			80° to 150°F.			150° to 225°F.			175° to 250°F.			60° to 120°F.	

Sampling and testing of road tar shall be in accordance with the following standard methods of the A.A.S.H.O.:

(a) Sampling.....T-40 (b) Specific Viscosity.....T-54 (c) Float Test.....T-50 (d) Specific Gravity.....T-43 (e) Total bitumen.....T-44 (f) Water.....T-55 (g) Distillation.....T-52 (h) Softening Point.....T-53

Table 3. Summary of Specifications for Road Tars

Table 4. Specifications for Type SC Materials

(Adopted May 14, 1940.)

Specification Designation	SC-0	SC-1	SC-2	SC-3	SC-4	SC-5
General Requirement	The material shall meet the following requirements when tested in accordance with the methods hereinafter enumerated.					
Furol Viscosity at 77°F.	75-150	-	-	-	-	-
" " " 122°F.	-	75-150	-	-	-	-
" " " 140°F.	-	-	100-200	250-500	-	-
" " " 180°F.	-	-	-	-	125-250	300-600
Water, per cent	0.5-	0.5-	Material shall be free from water.			
Flash, Cleveland Open Cup, °F.	150+	150+	175+	200+	225+	250+
Distillation						
Total Distillate to 680°F.	15-40	10-30	5-25	2-15	10-	5-
Float Test on Residue at 122°F., sec.	15-100	20-100	25-100	50-125	60-150	75-200
Asphalt Residue of 100 Penetration %	40+	50+	60+	70+	75+	80+
Ductility Asphalt Residue at 77°F.	100+	100+	100+	100+	100+	100+
Per cent Soluble in Carbon Tetrachloride*	99.5+	99.5+	99.5+	99.5+	99.5+	99.5+

*Note: - If the material fails to meet the requirement for solubility it will be acceptable if its solubility in carbon disulphide is 99%+, and proportion of bitumen soluble in carbon tetrachloride is 98.65%+.

Table 5. Specifications for Type MC Materials

(Adopted December 13, 1939.)

Specification Designation	MC-0	MC-1	MC-2	MC-3	MC-4	MC-5
General Requirement	The material shall be free from water and shall meet the following requirements when tested in accordance with the methods hereinafter enumerated.					
Flash Point (Open Tag.) °F.	100+	100+	150+	150+	150+	150+
Furol Viscosity at 77°F.	75-150	-	-	-	-	-
" " " 122°F.	-	75-150	-	-	-	-
" " " 140°F.	-	-	100-200	250-500	-	-
" " " 180°F.	-	-	-	-	125-250	300-600
Distillation						
Distillate (per cent of total distillate to 680°F.)						
To 437°F.	25-	20-	10-	5-	0	0
" 500°F.	40-70	25-65	15-55	5-40	30-	20-
" 600°F.	75-93	70-90	60-87	55-85	40-80	30-75
Residue from distillation to 680°F. Volume per cent, by difference	50+	60+	67+	73+	78+	82+
Tests on Residue from Distillation						
Penetration 77°F., 100 g., 5 sec.	120-300	120-300	120-300	120-300	120-300	120-300
Ductility 77°F.*	100+	100+	100+	100+	100+	100+
Per cent Soluble in Carbon Tetrachloride	99.5+	99.5+	99.5+	99.5+	99.5+	99.5+

* Note. - If penetration of residue is more than 200 and its ductility at 77°F. is less than 100, the material will be acceptable if its ductility at 60°F. is 100+.

Table 7. Specifications for Emulsified Asphalts

SPECIFICATIONS FOR EMULSIFIED ASPHALTS

(Adopted September 11, 1940)

Specification Designation	Rapid Setting: RS-1	Medium Setting: MS-1	MS-2	MS-3	Slow Setting: SS-1	SS-2
Tests on Emulsion						
Viscosity, Furol @ 77°F., sec.	20-100	20-100	100+	-	20-100	20-100
Residue by Distillation	55+	55+	60+	65+	55+	55+
Settlement, 5 days	-3	-5	-5	-	-3	-3
Demulsibility (a) 35 c.c. N/50 $CaCl_2$	60+	-	-	-	-	-
(b) 50 c.c. N/10 $CaCl_2$	-	-30	-30	-	1.0-	1.0-
Sieve Test - Ret. on 20 Mesh	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10
Miscibility, 2 hrs.	-	Pass	Pass	Pass	Pass	Pass
Stone Coating (3 min.)	-	Pass	Pass	Pass	-	-
Cement Mixing, % Max.	-	-	-	-	2.0-	2.0-
Tests on Residue						
Penetration @ 77°F., 100g., 5 sec.	100-200	100-200	100-200	100-200	100-200	40-90
Soluble in CS_2 (Pet. Asphalt) %	97.5+	97.5+	97.5+	97.5+	97.5+	97.5+
" " " (Nat. Asphalt) %	95.0+	95.0+	95.0+	95.0+	95.0+	95.0+
Ash	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Ductility @ 77°F., cm.	40+	40+	40+	40+	40+	40+

Principal uses of the emulsified asphalts as specified in the accompanying table are as follows:

RS-1—These specifications cover emulsified asphalt for penetration and surface treatment.

MS-1—These specifications cover a low consistency emulsified asphalt for road-mixes with coarse aggregate, substantially all of which is retained on a ⅛" sieve and with practically no material passing a No. 200 sieve.

MS-2—These specifications cover a medium consistency emulsified asphalt for plant mixes with coarse aggregate, substantially all of which is retained on a ¼" sieve and with practically no material passing a No. 200 sieve.

MS-3—These specifications cover a high consistency heavy pre-mix grade of emulsified asphalt, for plant mixing or patching with coarse aggregate, substantially all of which is retained on a ⅛" sieve and with practically no material passing a No. 200 sieve.

SS-1—These specifications cover emulsified asphalt for fine aggregate mixes in which a substantial quantity of aggregate passes a ⅛" sieve and a portion may pass a No. 200 sieve.

SS-2—These specifications cover emulsified asphalt (of low penetration) for fine aggregate mixes and for admixture with soil aggregates in which a portion passes a No. 200 sieve.

as specified by the engineer or shown on the plans.

c. Construction Methods.—The stabilizing material shall be delivered and spread uniformly on the subgrade, when the same is in suitable condition in the judgment of the engineer. It shall be spread to such a depth that, when the work is completed, the requirements of the typical cross-section will have been fulfilled. To accomplish this, the Contractor shall deliver the required amount of material within each 100-ft. station and shall distribute it uniformly within the limits of that station. In hauling and placing, the work (unless otherwise directed by the Engineer) shall start at the station furthest from the source of supply and progress toward it. Hauling over the surface will not be permitted until after mixing and shaping.

After placing and spreading, the stabilizing material shall be incorporated by plowing and harrowing with the material of the subgrade, and then rolled. The Engineer may require wetting of the material, if necessary for proper consolidation. The Contractor shall manipulate and machine the surface as directed, until the subgrade is hard and smooth and conforms to the grade and cross-section shown on the plans.

d. Measurement. — All acceptable material placed will be measured in cubic yards, loose volume, in the transporting vehicle, at the place where used on the road, unless hauled by scrapers, in which case the material will be measured in its original position. Overhaul will be paid for (in the usual local manner).

e. Payment.—Payment will be made on the basis of accepted subgrade treatment material in place at the contract price per cubic yard, which shall be payment in full for furnishing, freighting, hauling, loading and unloading, spreading, incorporating, rolling, working, machining, watering and maintaining until acceptance, and for furnishing all equipment, tools, labor and materials to do the work. Separate payment will be made for overhaul and for stripping from pits.

(To be continued next month)

Triple Water Supply for Ordnance Plant

The Alabama Ordnance Works, which has been completed by E. I. du Pont de Nemours & Co. for the United States Army in ten months instead of the twelve allotted by contract, covers 15,000 acres of ground and will use approximately 15 mgd of water, which is distributed through the plant by 46 miles of cast iron pipe varying in size from 4" to 16", about 27 miles being 6" and 8". The water used is drawn from the Coosa river, on the banks of which the plant is situated, and is distributed through a three-fold system; one system carries filtered water for human consumption, the second carries larger amounts of unfiltered water for processing purposes; and the third is a high-pressure system for fire protection. A filtration plant and storage tanks are provided; and a sewage treatment plan.

Table 6 Below

At right: Cut-back Asphalts

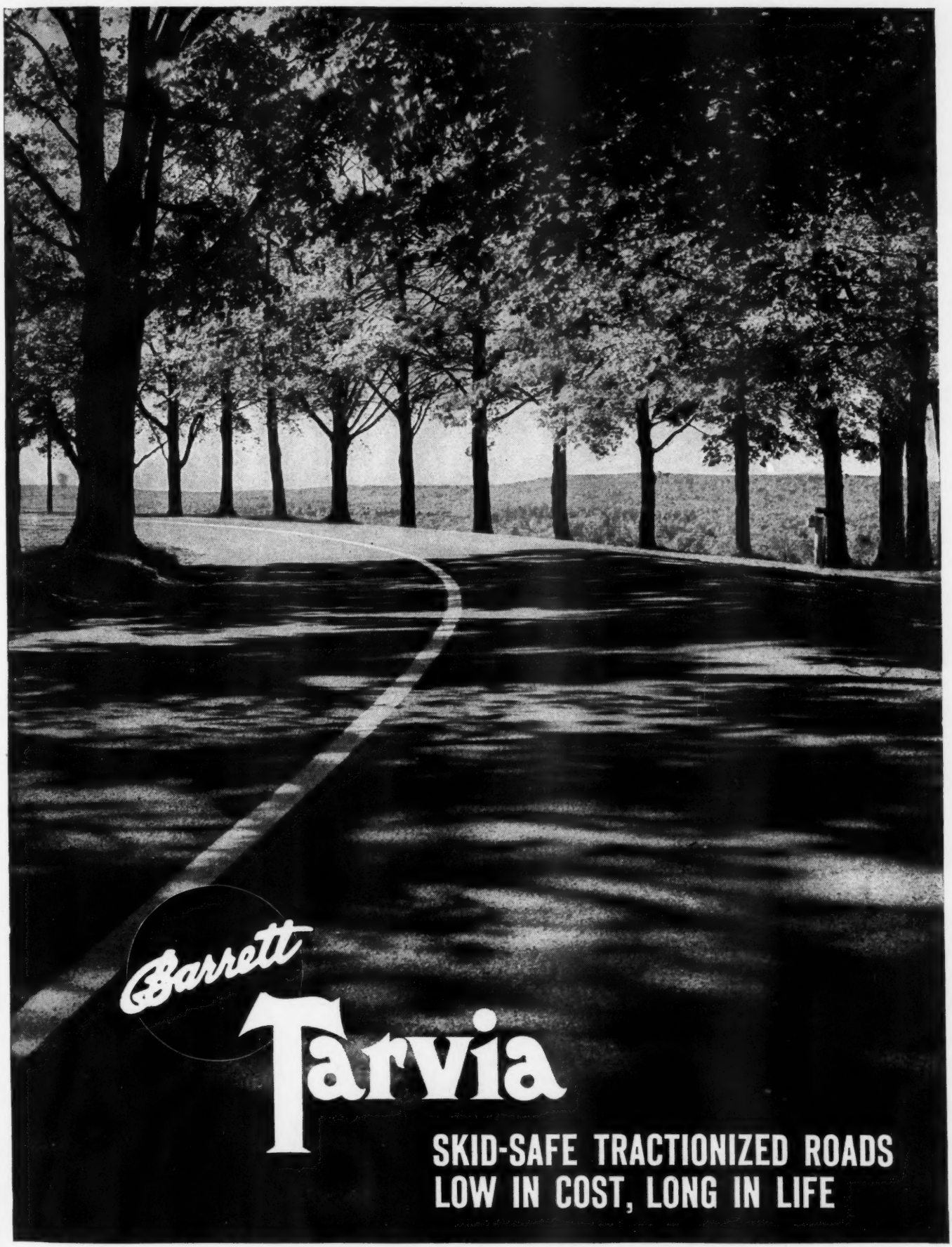
SPECIFICATIONS FOR TYPE RC MATERIALS

(Adopted December 13, 1939.)

Specification Designation	RC-0	RC-1	RC-2	RC-3	RC-4	RC-5
General Requirement	The material shall be free from water and shall meet the following requirements when tested in accordance with the methods hereinafter enumerated.					
Flash Point (Open Tag.) °F.	-	-	80+	80+	80+	80+
Furol Viscosity at 77°F.	75-150	-	-	-	-	-
" " " 122°F.	-	75-150	-	-	-	-
" " " 140°F.	-	-	100-200	250-500	-	-
" " " 180°F.	-	-	-	-	125-250	300-600
Distillation						
Distillate (per cent of total distillate to 680°F.)						
To 374°F.	15+	10+	-	-	-	-
" 437°F.	55+	50+	40+	25+	8+	-
" 500°F.	75+	70+	65+	55+	40+	25+
" 600°F.	90+	88+	87+	83+	80+	70+
Residue from distillation to 680°F. Volume per cent by difference	50+	60+	67+	73+	78+	82 -
Tests on Residue from Distillation						
Penetration 77°F., 100 g., 5 sec.	80-120	80-120	80-120	80-120	80-120	80-120
Ductility 77°F.	100+	100+	100+	100+	100+	100+
Per cent Soluble in Carbon Tetrachloride	99.5+	99.5+	99.5+	99.5+	99.5+	99.5+

Principal Uses of Materials Meeting New Specifications

SPECIFICATION	RC Rapid Curing						MC Medium Curing					
GRADES	0	1	2	3	4	5	0	1	2	3	4	5
Priming												
Tightly bonded surfaces												
Loosely bonded fine grained surfaces												
Loosely bonded coarse grained surfaces												
Seal and Carpet Coats												
with or without light sand cover												
Coarse sand cover												
Clean 1/4" aggregate cover												
Clean 1/2" aggregate cover												
Clean 5/8" aggregate cover												
Clean 3/4" aggregate cover												
Graded gravel aggregate cover												
Gravel mulch												
Road Mix												
Open graded aggregate												
Sand												
Max. dia. 1", high % pass. 10 mesh												
Macadam aggregate												
Dense graded aggregate												
High % pass. 200 mesh												
Max. dia. 1", med. pass. 200 mesh												
Cold Patch												
Open graded aggregate												
Dense graded aggregate												
Cold Laid Plant Mix												
Open graded aggregate												
Sand												
Max. dia. 1", high % pass. 10 mesh												
Macadam aggregate												
Dense graded aggregate												
High % pass. 200 mesh												
Max. dia. 1", med. % pass. 200 mesh												
Primer to be followed with soft A.C.												
Penetration Macadam (cold weather)												



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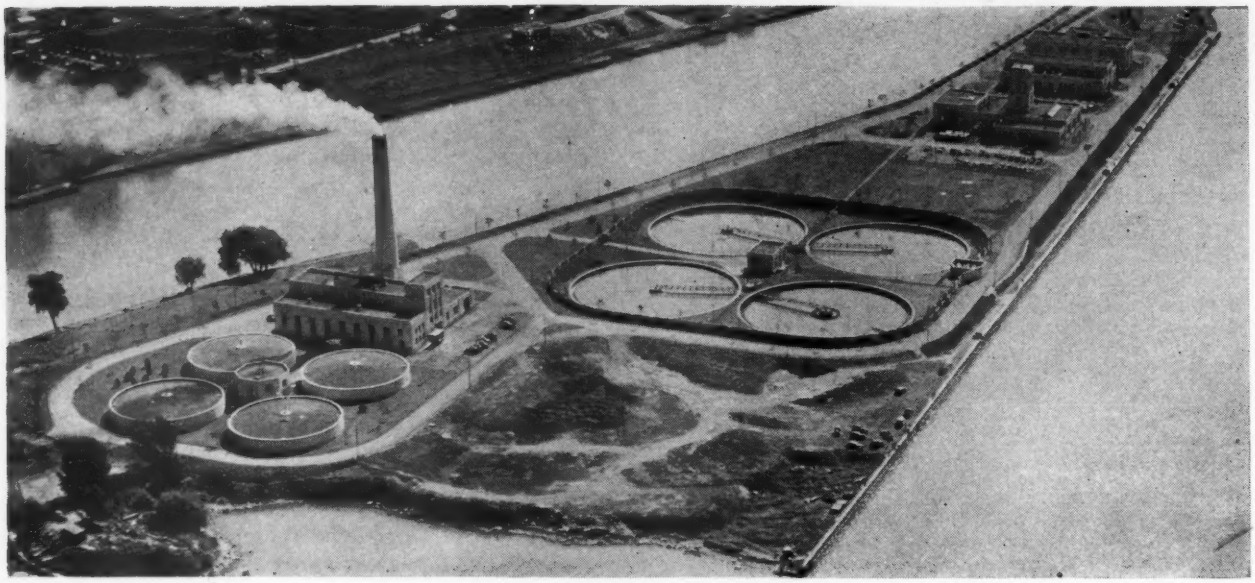


Airplane view of Buffalo Filtration Plant.

Third Year of Sewage Treatment Operation at Buffalo, New York

By CHARLES R. VELZY, JOHN W. JOHNSON, and GEORGE E. SYMONS
Respectively Works Superintendent, Asst. Works Supt., and Chief Chemist,
Buffalo Sewer Authority, Buffalo, New York.

(Continued from the January issue)

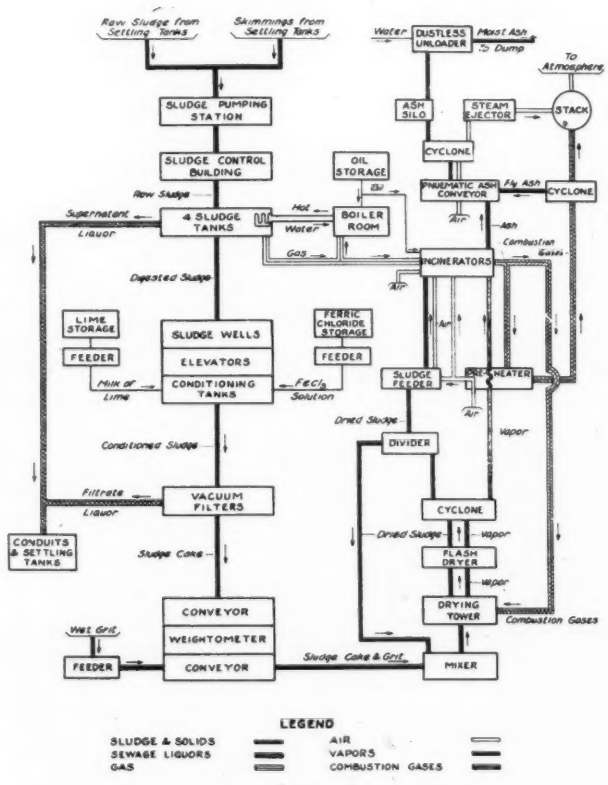
Sludge Digestion: The average daily volume of raw sludge pumped was appreciably less than in previous years, due to two factors (1) less supernatant liquor solids returned and (2) a higher concentration of sludge solids pumped.

The condition of the sludge digestion tanks was satisfactory and normal as regards pH, alkalinity and volatile acids. Sludge inventory varied, being rather high in the summer months and low in the winter. The amount of top sludge remained relatively constant, but its temperature varied with the seasons while the concentration varied inversely with the temperature.

Gas production varied with the loading and on the average was greater in quantity than previous years. The per cent digestion was 45.3 per cent as calculated from the change in volatile matter content during digestion or 39.4 per cent as calculated by the following equation:

$$\frac{\text{Weight of gas}}{\text{Total raw solid loading}} = \% \text{ digestion}$$

Solid Disposal: Both the volume and weight of digested sludge drawn for burning increased, consistent with the higher loading of raw solids and the lower concentration of digested sludge drawn. Calculations based on the sludge filter cake analysis show that an average of 50,600 lb. of sludge solids were burned per calendar day which, with the lagooned sludge, averaged 52,600 lb. per day of digested sludge solids drawn.



Flow sheet, solids disposal plant.

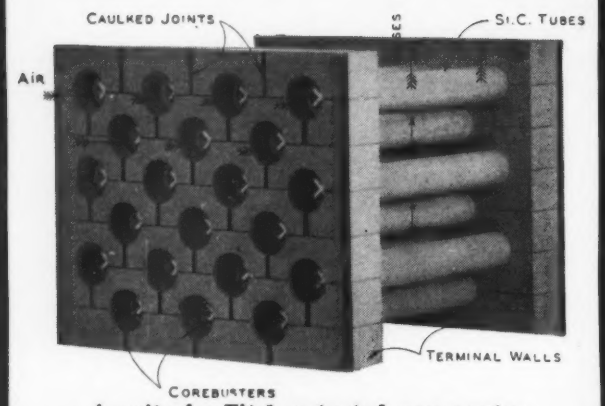
SUMMARY OF DATA FOR 1940-41

Item	*Max.*	*Min.*	*Avg.*	*Average Previous Year*
City water pumped—M.G.D.	155	89	114	112
Sewage flow—M.G.D.	348	88	140	135
Suspended Solids:				
Raw sewage—p.p.m.	520	32	168	165
Raw sewage—lb./cap/day	1.60	0.06	0.33	0.31
Influent—p.p.m.	522	40	177	205
Effluent—p.p.m.	504	38	110	113
Removal of Suspended Matter:				
Overall—per cent	82.6	—71.4	34.8	31.5
By clarifier—per cent	205.3	—74.9	28.5	26.5
Settleable solids removed by clarifier—per cent	285.8	—141.3	73.9	85.4
Grit removed, cu. ft. per M.G.	16.2	0.5	2.71	3.80
1000 lb. per day—wet	210.7	2.8	21.4	28.8
% dry solids	87.1	24.5	52.2	53.6
1000 lb. per day—dry	107.0	1.1	11.2	15.4
% volatile matter	92.4	10.7	42.2	37.2
pH of raw sewage	8.0	6.2	7.3	7.3
5-Day B.O.D.:				
Raw sewage—p.p.m.	246	35	127	137
Effluent—p.p.m.	198	31	101	105
Removal—lb./day	175	—130	30.7	32.1
Removal—per cent	68.5	— 55.4	20.7	23.1
Disinfection:				
Chlorine demand, raw sewage—p.p.m.	13.2	3.6	6.27	5.40
Supernatant—p.p.m.	1,570.	22.	208.	239.
Total—p.p.m.	13.3	3.7	6.50	5.90
Final effluent—p.p.m.	3.8	0.0	0.85	0.86
Per cent satisfaction, dose/demand—per cent	145.0	35.0	86.9	84.0
From 15 min. residual—per cent	108.7	30.9	94.0	90.3
Coliform bacteria, raw—per ml.	625,600	4,300	56,400	72,500
Effluent—per ml.	13,400	0.2	915	1,300
Per cent kill	99.9	60.9	98.4	98.2
Raw Sludge:				
1000 gallons per day	506	26	172	343
Per cent dry solids	12.5	1.40	7.23	6.62
Per cent volatile matter	80.3	25.3	62.9	56.4
Sludge Digestion:				
Tank Temp.— °F.	99	77	89.4	85.6
Per cent digestion			39.4	40.4
Gas produced—cu. ft./day	1,133,400	141,700	516,400	476,000
% CO_2	37.7	31.8	34.5	34.2
% CO_4	67.5	61.4	63.9	63.3
Supernatant liquor drawn, 1000 gal. per day	630	—	161	282
Per cent dry solids	10.2	0.14	2.36	3.91
Per cent volatile matter	73.6	24.5	50.2	47.0
Digested sludge drawn, 1000 gallons per day	224	—	74	59
Per cent dry solids	15.8	5.44	9.11	10.13
Per cent volatile matter	66.9	30.6	47.5	42.9
Sludge Dewatering:				
Lime—90% CaO—per cent			11.21	11.62
$FeCl_3$—anhyd.—per cent			2.93	3.10
Sludge cake—% dry solids	50.5	30.1	36.9	37.8
Sludge cake—1000 lb./day	166	—	59	59
Sludge cake—% vol. mat.	56.1	21.5	42.9	38.1
Sludge cake—B.t.u. per lb. D.S.	5,240	3,100	4,320	3,790
Hours per cloth			211	200
Yield—lb./sq. ft./hr.			6.77	7.58
Incineration—(per calendar day)				
Furnace hours per month			857	769
1000 lb. wet cake	450		158	158
1000 lb. dry solids	166		59	59
1000 lb. grit burned (dry)	56		5.06	5
1000 lb. dry solids burned per day	79		64.06	64
Lb. D.S. burned per furnace hr.			2,260	2,550
Gas used—cu. ft./lb. dry solids			1.23	1.35
Steam production—1000 lb./day	317	13	162	173
Gas equivalent consumption per lb. of steam			2.16	2.17

Chemical dosage improved over previous years, but the average was still high compared with the values obtained during one month of careful control, as indicated in Plate II. Hours of filter operation increased, partly due to the slightly wetter sludge cake, but mainly due to the decreased yield. Filter cloth life increased 5.5 per cent, but the volume of filtrate liquor per cloth decreased 19 per cent. Whether there is any relation between yield and cloth life is not apparent from these data.

Consistent with a higher volatile matter content of the digested sludge, the heat value of the sludge cake was high and this, in turn, undoubtedly, caused a decrease in the amount of dry solids burned per furnace hour. With the higher heat value of the cake, less gas was used per pound of dry solids burned The total dry solids burned, amounting to 11,613 tons, averaged per calendar day practically the same as the previous year.

Of the 516,400 cu. ft. of gas produced per day, 55.2 per cent was used in the boilers, and 15.1 per cent was used in the incinerators. Steam production



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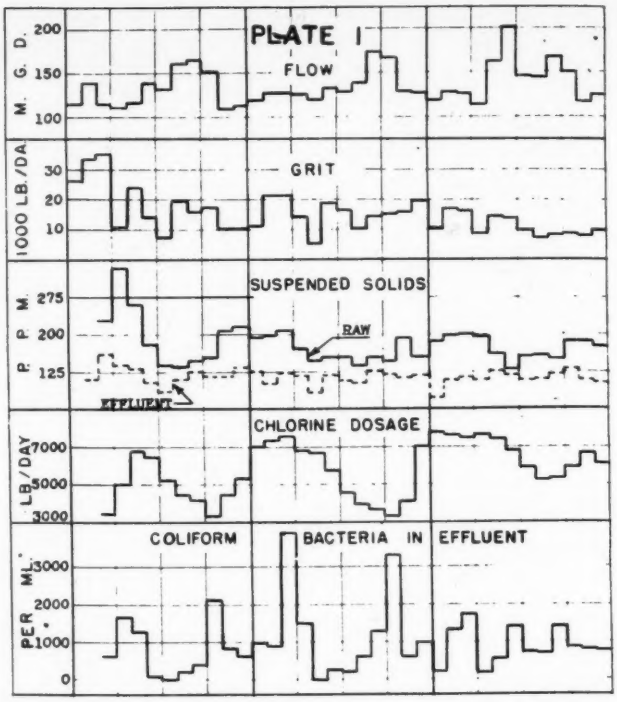

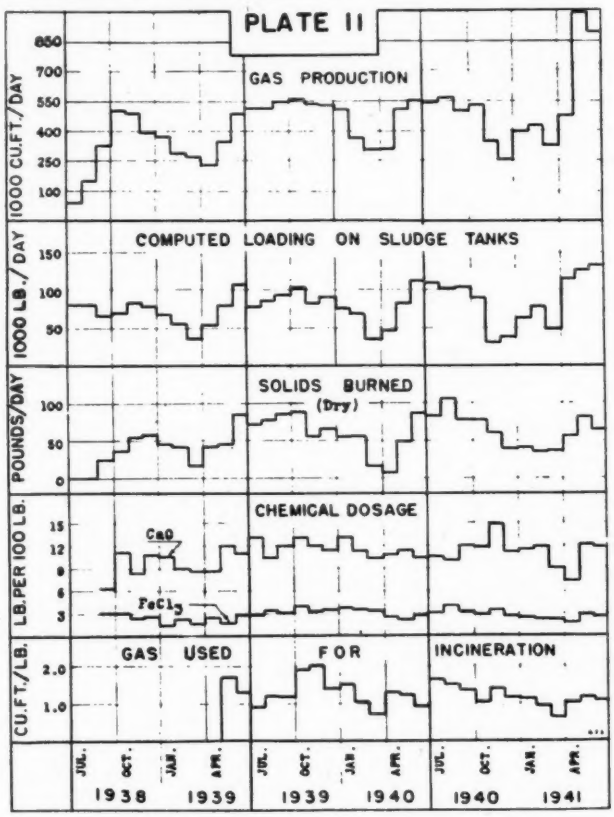

Plate I—Monthly averages of laboratory data.

Plate II—Results obtained in solids disposal.

was normal and the gas equivalent to produce the steam was 2.16 cu.ft. per pound.

Solids Balance: As indicated in the section on solids removal, the calculation of a solids balance on the basis of suspended solids removal appears to be an impossibility, and data on raw sludge solids, when corrected for returned supernatant liquor solids, appear low when consideration is given to the actual weight of sludge solids burned and the amount of gas produced.

In view of the fact that both the gas quantity and the weight of sludge burned are ascertained with a relatively high degree of accuracy, it is the practice to calculate the raw solids loading on the digestion tanks from these two items and the chemicals used. Two assumptions are made and both probably lie within the limit of error of the measurements; first, that the weight of gas produced is equal to the weight of sludge solids digested and, secondly, that chemicals used in sludge conditioning appear in the sludge cake, i.e., the soluble matter in the filtrate is negligible.

The calculation of the loading on the sludge digestion tanks is shown in the following summary:

(1) Total sludge cake burned (dry basis)		21,378,000 lb.
(2) Anhydrous ferric chloride used	543,300 lb.	
(3) Available lime used	2,080,120	
(4) Impurities in lime (at 91.21% CaO)	200,420	
(5) Total chemicals used	2,823,840 lb.	2,823,840
(6) Dry sludge solids burned (1)-(5)		18,554,160 lb.
(7) Gas produced (188,471,000 cu. ft. at 14.7 cu. ft. per lb.)		12,821,140
(8) Sludge solids lagooned		723,000
(9) Total solids removed from sludge tanks (6)+(7)+(8)		32,098,300
(10) Sludge inventory—June 30, 1941		5,500,000
(11) Sum of (9) & (10)		37,598,300
(12) Sludge inventory—June 30, 1940		5,020,000
(13) Sludge tank loading (11)—(12) (equiv. to 89,300 lb./day)		32,578,300 lb.

On this basis, the suspended solids data account for only 63.4 per cent, and the raw sludge data for only 80.6 per cent of the total solids actually removed in the clarifiers.

Operating Costs

The breakdown of the actual expenditures for operating the sewage treatment works, including the outlying pumping stations, is shown in Table II, together with costs for last year. Generally, most items were less than the previous year and the cost of operation for 1940-41 was $11,562.88 less than last year for the same items. The economy of a new outlying pumping station over the old steam pumping station was quite obvious in this first full year of operation of the new station.

This decrease in cost coupled with an increased volume of sewage resulted in a lower cost per million gallons pumped. Cost of the main pumping station was $0.90 per million gallons, compared with $1.03 for the same item last year. Other items, with the exception of maintenance, also cost less per million gallons. Including all items for both years, as in Table II, the cost in 1940-41 was $8.25 per million gallons as compared to $8.78 per million gallons in 1939-40.

Visitors

As in the previous two years, many persons visited the treatment works. Individuals were conducted through the plant by watchmen-guides, and each visitor received a copy of the pamphlet describing the operation of the plant. Groups and organizations who inspected the plant by appointment numbered 44 and included Boy Scout troops, University and High School classes, student nurses and doctors, business, professional and church groups and others. Out-of-town visitors numbered 56 and included engineers, chemists, and other professional men from many cities and some foreign countries.

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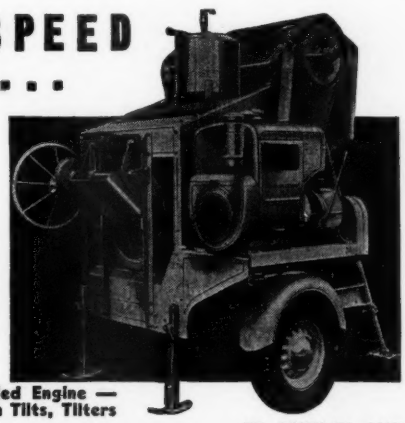

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16. G. E. Symons, "Sludge Digestion Tank Inventory at Buffalo, N. Y.," Sew. Wks. Engr. (in press).

Glassy Slag in Bituminous Paving

In the various States that use blast-furnace slag as a road-building material, there appears to be considerable difference of opinion as to the amount of restriction that should be placed on the percentage of glassy particles in slag aggregates for bituminous paving mixtures. Glassy particles have been considered detrimental because it was feared that their smooth surface texture would impair the stability of bituminous mixtures and that the bituminous film would not adhere to them in the presence of water.

From an investigation made by the Division of Tests, Public Roads Administration, to determine whether the stability and resistance to film stripping of bituminous paving mixtures prepared from slag aggregates were affected materially by the glassy-particle content of the slag, it was concluded:

1. The susceptibility to film stripping of the mixtures containing the six slags that were tested was not affected materially by variations in the content of glassy particles.

2. For bituminous mixtures containing 0, 15, and 30 percent of glassy particles in the fraction retained on the No. 4 sieve, the percentage of glassy material did not have a significant effect on stability.

3. The tests furnish no indication that specification requirements placing drastic limitations on the glassy-particle content of slag aggregates for bituminous concrete are necessary.

Lansing's Combined Garbage-Sewage Disposal

In publishing an article in our January issue describing the Lansing plant, we failed to give credit to the engineers who designed and constructed the plant, Shoecraft, Drury and McNamee; and to sufficiently designate the author of the paper from which our article was abstracted—Walter R. Drury, of that firm.

Constructing Air Raid Shelters

No one can say whether the United States soon will be bombed or not, but those communities desiring to be on the safe side will find much valuable information in this article on the protection of persons.

A bombed three-story building, showing outer wall pulled out by suction but floors and partition wall standing.

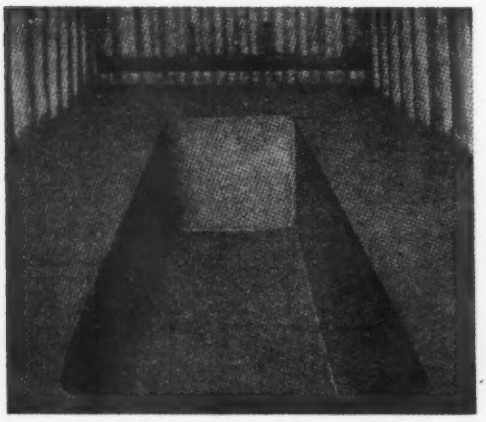
DAMAGE is done by air raids to both property and persons. Protection of the former is discussed in another article in this issue. The purpose of this article is to discuss protection of persons. The statements made herein are based on English and Spanish experience.

Air raid damage in this war is caused entirely by bombs of two classes—incendiary and explosive. The former seldom weigh over two to five pounds, and while even this weight hitting a man after a fall of 5,000 ft. or more would cause serious if not fatal harm, its ability to cause a fire is the danger chiefly to be guarded against. Air raid shelters should be fireproof.

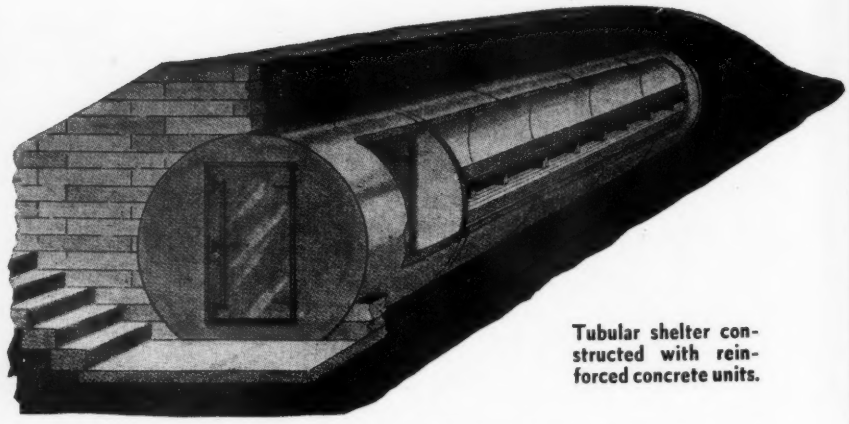
Explosive bombs weigh from 110 to 4,000 lbs. They exert their destructive effect in four ways: 1—Penetrating the ground to a depth of 8 to 30 ft., their explosion creates ground tremors similar in effect to seismic ones, jarring and twisting walls of buildings, sometimes causing the collapse of buldings one or more hundred feet away by this means alone, and at least causing plaster to fall from ceilings and walls over a large area. 2—The explosion blows out a crater of earth and throws to a distance of several hundred feet hundreds—often thousands—of cubic feet of earth, paving materials, broken pipes and pieces of the bomb itself. 3—The explosion compresses the air above and around the crater, this pressure being so great that any human being less than 250 ft. away from a 1,000 lb. bomb may be crushed to death by it; but the pressure varies inversely as the cube of the distance and at 400 ft. the pressure is seldom fatal except as the person may be thrown against a wall or other solid object. This pressure blows in windows not adequately protected, hurling broken glass into the building; sometimes pushing in the walls as well, but this is generally prevented by the bracing afforded by the floors and the side and partition walls. 4—As the compressed air moves up and outward from the bomb it causes a vacuum which sucks out the walls, and as the interior walls afford little resistance to this (except in steel framed construction) most of the damage to buildings is caused in this way, the walls falling outward. If, as is generally the case, the floor beams are parallel to the exposed walls (assuming city construction with buildings contiguous, with party walls) the floors in a great many cases remain standing.

A bomb that hits the roof or wall of a building (the bomb is generally traveling in a line 15° to 30° from the vertical) will pass through several floors—an indefinite number of wood-beam floors—and, exploding in the cellar, is pretty sure to wreck the house, and probably those adjacent on each side. In England, 500 lb. bombs have passed through a roof and five floors of 6″ reinforced concrete.

Modern buildings of steel frame construction have seldom if ever been destroyed by bombs; the walls may be blown out, but the framework and floors will stand. It is possible that a bomb bursting near the foundation might so shear or distort a number of the main columns as to cause the structure to collapse; but this, we believe, has never occurred. However, experience with buildings more than eight or ten stories high is lacking. Some English factories, store houses, etc., have been built of steel frames with walls of corrugated steel plates, and although these walls have been blown entirely off, the frames have been uninjured and new walls replaced in a few hours. A mason-



An "Anderson" shelter in wet soil, made water tight by placing water-tight steel tank in the bottom and filling with concrete between it and the shelter walls.



Tubular shelter constructed with reinforced concrete units.

Above illustrations courtesy The Trussed Concrete Steel Co., Ltd., The Stanton Iron Works Co., Ltd., and The Surveyor.

ry wall only high enough to protect man and machinery inside, with the wall above it easily blown out as a safety valve was recommended by the Ministry of Home Security.

For protection against bomb fragments from a 500 lb. bomb exploding 50 ft. away, British authorities recommend thickness of various materials as follows: Steel plates, 1½"; solid masonry, 13½"; reinforced concrete, 12"; plain concrete, 15"; earth or sand, 30"; broken stone, gravel &c., 24"; wood, 40" minimum. Objects thrown by bombs seldom penetrate walls of buildings; they enter windows with a velocity that causes them to remain above window sill level, following a fairly straight trajectory until striking the wall opposite or ceiling above.

The Englsh recommend that the size of shelters be calculated on the basis of 6 sq. ft. floor area per person for small ones; 3.75 sq. ft. for large ones. The minimum size should be 4'-6"x4'-2"; adequate for three persons. Whatever the dimensions, there should be 50 cu. ft. of air per capita. Not more than 50 persons should be placed in any one compartment.

With these in mind, protection for persons can be planned on something like a scientific basis. First, it is certain that it is impracticable to construct an air raid shelter unless well below the ground surface, that will protect its occupants against a direct hit by a large bomb, for a bomb of the largest size will penetrate 7 or 8 feet into a solid mass of reinforced concrete. The aim, therefore, is to protect against flying objects and falling plaster, floors and walls, and air pressure and vacuum.

Shelters Inside Buildings

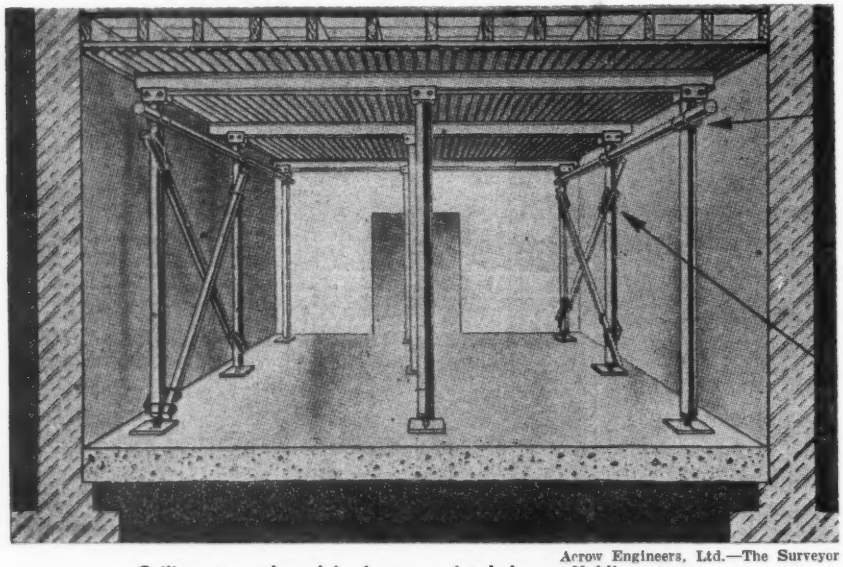
A shelter in any building should place a wall between the persons sheltered and all windows. More injuries have been caused by flying glass than in any other way. The shelter should have a roof strong enough to support plaster and other falling debris. The British use the following weights of debris in their calculatons:

Stories above shelter	*Static load lb. per sq. ft.*
1-2	200
3-4	300
5 and over	400

Skeleton Construction

Unlimited	200

The shelter should be of sufficient size to receive all the occupants. (See figures above for areas and volumes.) It should have at least two exits, to provide against one being blocked. The second exit is preferably just large enough to allow a person to crawl through and should be closed substantially, but in such a way that it can be opened after the danger is over—plank on the outside nailed on lightly, or sand bags, or brick laid up dry have been used. Provision should be made for lighting and especially for ventilation.



Acrow Engineers, Ltd.—The Surveyor

Ceiling strengthened by beams and tubular scaffolding struts.

In tall buildings of steel frame construction the safest place would seem to be at least seven floors below the roof, and preferably two or three above the ground, with at least one solid wall between the point selected and the outside wall. Such a spot is probably as safe as any in the city.

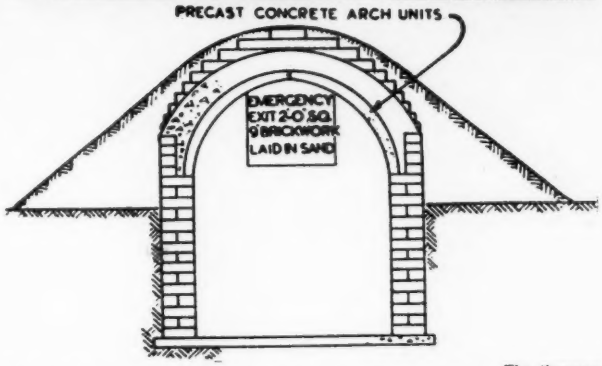
If a building of this construction is less than eight stories high, a basement or cellar shelter is desirable. Here a regular shelter should be provided, preferably against an outside wall through which an emergency exit is cut. If placed against the foundation of a party wall, an opening through this wall with a shelter on each side, one for each building, furnishes a second exit for each. (See also remarks under the head

of "Public Shelters"). The ceiling above the shelter should be reinforced with beams supported by heavy posts to help support the debris that may fall there from collapsed floors above; and unless the floor immediately above the shelter is of very heavy construction it should be covered with several feet of sand, cinders, dry earth, etc., to receive impact of falling beams or masonry and protect against fire. Abundant means of quick access from all parts of the building should be provided and always kept free for use.

In a residence or other building of light frame construction, protection is sometimes limited to a structure in a hallway or room that will protect from flying objects and falling ceilings. In England a shelter made of corrugated steel, with arched roof and vertical sides (similar to a culvert), and with attached floor, so that it forms a movable self-contained unit, was recommended by Sir John Anderson, the Home Secretary, and several million were furnished to citizens for either in-door or out-door shelters. One of these placed in a room affords protection against glass, splinters and plaster; and, should the floor collapse, might even fall to the cellar with little damage to the occupants other than bruises. Perhaps the simplest and least obstructive shelter is a long, heavy table set against a partition wall, the front protected by boards or even small-mesh chicken wire (since projectiles from an outside bomb can not reach it, but the blast of compressed air might break and splinter a solid barrier).

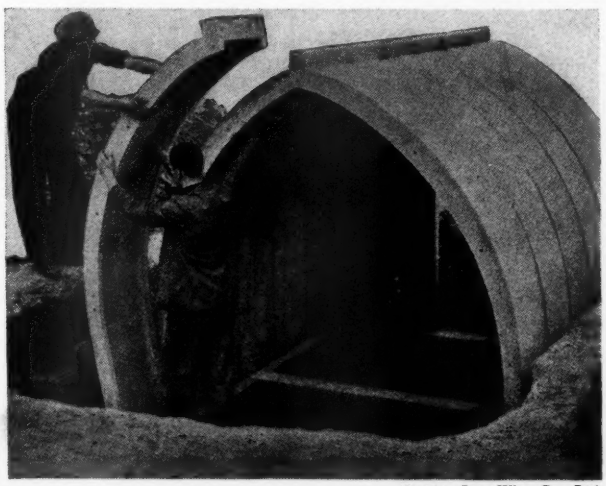
Much safer is a cellar shelter. For a domestic cellar shelter the following construction is suggested as simple and effective. Select a spot next to an outside cellar wall which supports the ends of the floor beams above, which is readily accessible, above which is no very heavy object and in which are no gas or water pipes. If there is no cellar window here, cut a hole through the top of the wall large enough to serve as emergency exit. Place sand bags over the outside of this opening, or planks lightly nailed in place so they can be pushed out. If the shelter is in a corner of the cellar, it saves building one end wall. Parallel to the wall and about 5 ft. from it set a line of heavy posts, one under each floor beam, to serve as studs for the shelter wall and supports for the floor above; extending these supporting posts about 5 ft. beyond each end

Surface shelter, using successive layers of steel plate, concrete, broken stone, and earth with total thickness of about 4 ft. Design recommended by U. S. Corps of Engineers for the Army. (Courtesy Armco Drainage Products Assn.).



The Surveyor

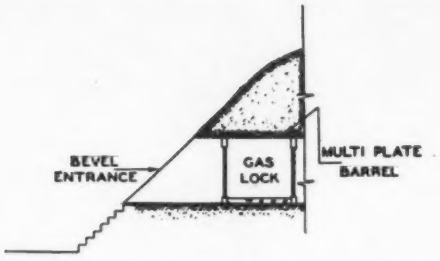
Shelter built using reinforced concrete pre-formed arch slabs on brick side walls, with brick end walls. Slabs are covered with 6" of concrete and earth embankment.



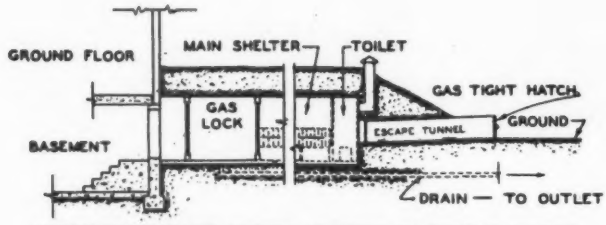
Stanton Iron Wks. Co., Ltd.

Building a shelter of pre-formed reinforced concrete units 20" wide, bolted together, with asphalt jointing material.

of the shelter. On the outside of these fasten a plank wall, and on the outside of this nail a covering of corrugated steel, asbestos or other fire-proof material; or build the wall of concrete. In one end wall place a door fastened with leather straps or other hinges easily forced out of place (in case the door should be blocked with debris on the floor.) Just under the floor beams place a ceiling of planks supported by studs and fill the space between this ceiling and the floor above with sand, ashes, dry dirt or other non-inflammable, cushioning material. In the shelter provide a bench or chairs, an electric light, a flash light (the electric wires may be broken), an electric heater, a chemical toilet, a tub of water for drinking or fighting fire. A portable radio for hearing "all clear" or other announcements is desirable.



METHOD OF INSTALLING SHELTER IN HILLSIDE LOCATION



METHOD OF INSTALLING SHELTER ADJACENT TO EXISTING BUILDING
ENTRANCE AND EXPLOSION WALLS OMITTED

© *Armco*

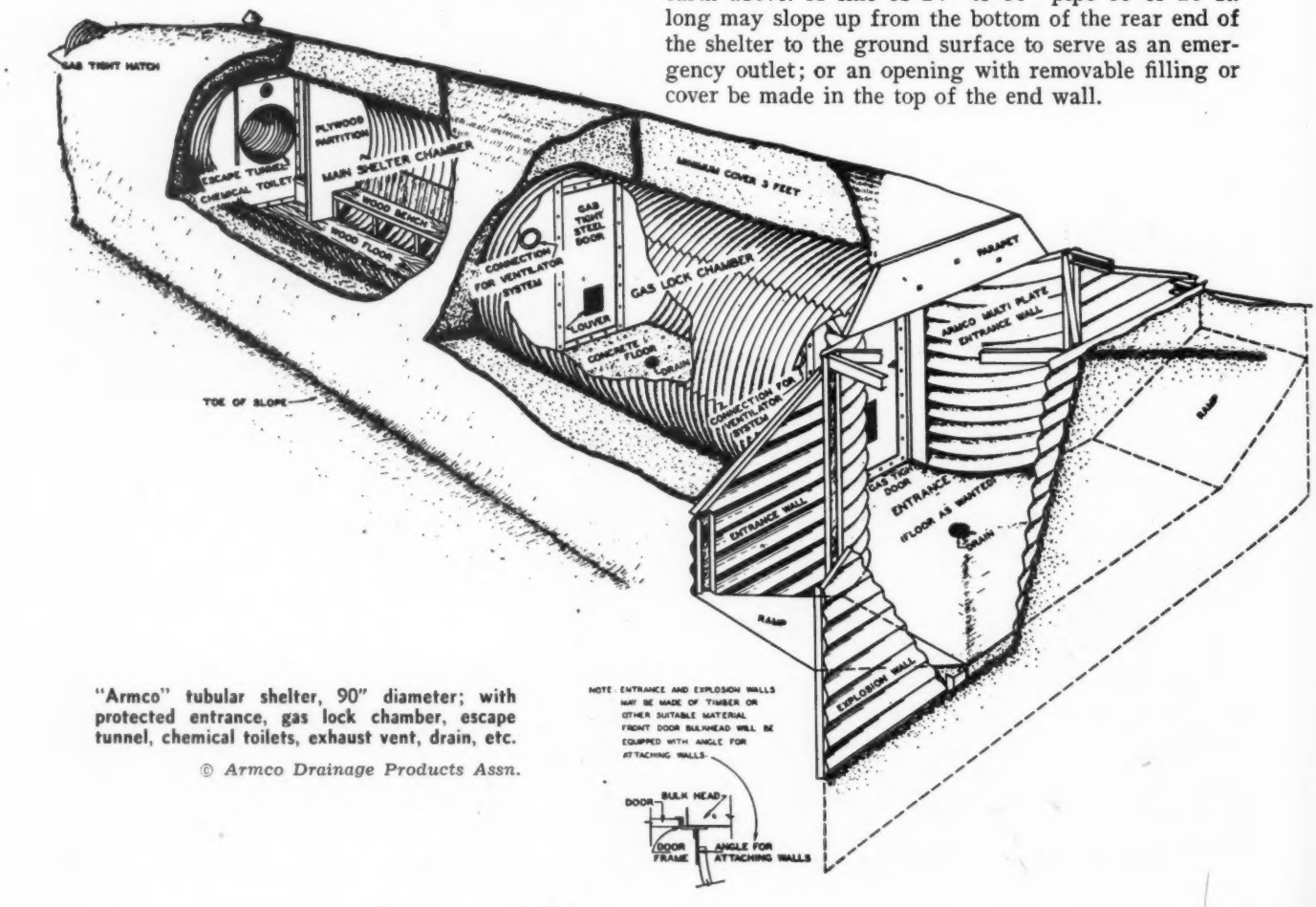
Instead of this, a pre-fabricated shelter of corrugated steel, reinforced concrete or other may be used, with emergency exit through the wall, and with the floor above propped as described above and a sufficient covering of earth or sand bags banked alongside and over the shelter.

Outside Shelters

Outside "garden" shelters (as the English call them) should be placed as far as possible from any building, so that falling walls may not cover and perhaps crush them. (Some, however, recommend a shelter built against the house wall, with a door in this wall giving instant access from the house. Such a shelter should be strong enough to support the weight should the entire wall of the house fall upon it. There is also the danger of the house catching fire.) Placing a shelter underground gives the greatest security against flying objects and air blasts; but protection from flooding by ground or surface water should be insured. In England, during the first year of the war, hundreds of miles of trenches were dug for shelters, and thousands of Anderson shelters were set partly or wholly below the surface; but most of these collected water (England is a rainy country) and have been abandoned. In dry ground, with the surface sloped away from the shelter in all directions, or by supplying adequate pipe drains, this trouble could be avoided. Or the excavation can be made watertight with waterproof construction of floor and walls. Most English shelters now are placed above ground or depressed to such an extent that the excavated earth suffices for the outside covering.

The English developed many types of shelters, several of which are illustrated herewith. In practically all of them, earth is banked around and over them; a minimum cover of 15″ being required at all points. (Later experience indicates that this should be 30″). Partly sinking and mounding the shelter makes it easier to heat it. The earth cover should be placed in 6″ horizontal layers, puddled and thoroughly tamped; and when finished should be given a smooth surface that will shed water. (A cover of tar paper would help in this.)

To protect the entrance to a shelter, an embankment of earth or masonry wall may be erected in front of and 2 to 4 ft. from it, and rising 2 or 3 ft. above it and extending 3 or 4 ft. beyond each side of it. A ventilating pipe may rise from the roof through the earth above. A line of 24″ to 30″ pipe 15 or 20 ft. long may slope up from the bottom of the rear end of the shelter to the ground surface to serve as an emergency outlet; or an opening with removable filling or cover be made in the top of the end wall.



"Armco" tubular shelter, 90″ diameter; with protected entrance, gas lock chamber, escape tunnel, chemical toilets, exhaust vent, drain, etc.

© *Armco Drainage Products Assn.*

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"Armco" air raid shelter, 12′ 6″ wide by 8′ 4″ high, of ¼″ corrugated steel. To be placed above ground or wholly or partly under ground.

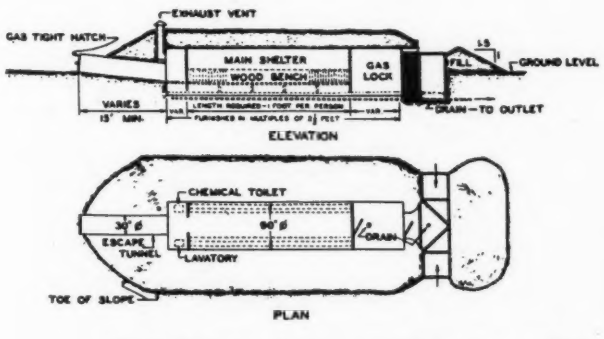
Small shelters that can be obtained ready made in a few pieces that can readily be fitted together are convenient. These pieces may be sections of large tubes of reinforced concrete or corrugated steel cylindrical or horse-shoe shaped, that are fitted end to end and fastened together; or iron castings, shaped steel plates or preformed reinforced concrete, in the form of flat slabs for floor and sidewalls and curved ones for the arch, that can be fitted and bolted or cemented together to form a rigid structure.

In case of a house collapsed over a cellar shelter, rescuers find it difficult to locate a shelter. An English suggestion is a plate set in the middle of the roadway in front of the shelter, appropriately marked; since the roadway generally receives the least debris and is cleaned for traffic first.

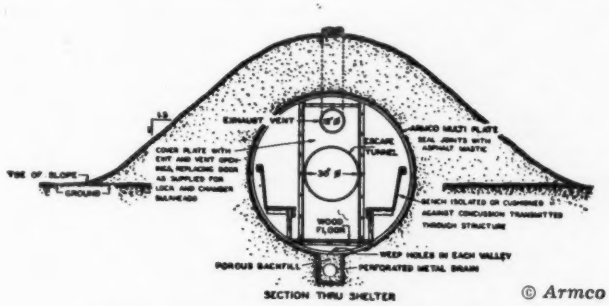
Ventilation of shelters is important. Electric fans set in ventilating outlets are desirable. English firms supply these provided with means for hand operation should the current fail. Perhaps the height of refinement in that country is lining concrete shelters with asbestos sound-absorbing pads, to diminish the air-raid noises that try the nerves of the occupants.

Public Shelters

Private shelters are expensive to build and not a convenient object to have in either the house or the yard; and most English cities are building public ones. It is assumed that an air raid warning can be given 7½ to 10 minutes before the bombs fall and, allowing time for rapid dressing, that persons can reach a shelter from all points within a radius of 900 ft. in day light or 450 ft. at night. Knowing the approximate population per acre of a district, the distribution and size of shelters can be calculated. Considerable thought should be given to the location of shelters, study being made of danger of falling walls or burning buildings, ground water, surface water drainage, proximity to water mains that may be broken, accessibility, etc.



Detail of shelter shown on opposite page. © *Armco*



© *Armco*

Cross section of shelter shown on opposite page.

In a closely built-up district, a shelter may be built in a cellar in the middle of a block, and openings made in all the partition walls between cellars so that all persons in the block can reach this shelter through the cellars. Such shelter should be made strong enough to support any weight that would come upon it should all the floors above and their contents fall into the cellar.

Many of the English shelters are dormitory shelters, with bunks for spending the night. Several of those built during the past six or eight months are described briefly. Cardiff is building 200 reinforced concrete dormitory shelters each to hold 48 persons; these to be in groups of 9 or 10 shelters surrounding a central canteen. Each 48-unit shelter is built as two compartments with a wall separating them, each compartment containing 8 tiers of 3 bunks each. The entrance is shielded by a separate structure 2′4½″ from it and containing two toilets. At the rear end of each is an emergency exit 2 ft. square filled with brick and protected by walls 2′4″ distant. The floor, walls and roof are of reinforced concrete, all tied together in a double box construction; the floor and roof 6″ thick, the walls 12″.

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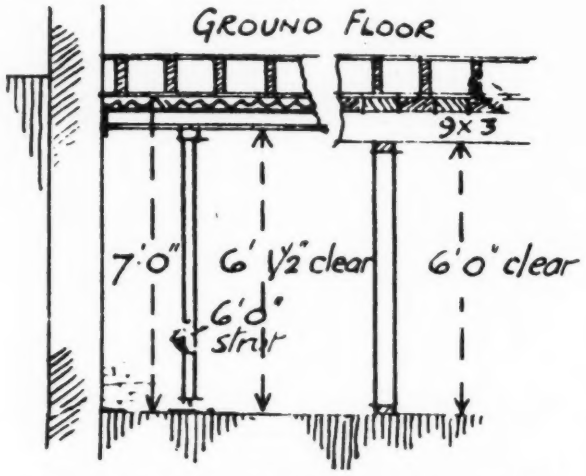
Manchester is building 100 shelters, using three different lengths—30 ft., 42 ft. and 57 ft., the last divided centrally by baffles. Each contains two heating stoves and two chemical toilets. Dronfield is building shelters for 12 persons with seating accommodation only; two or four being grouped together where more capacity is needed. Westminster has built a square 48-person shelter, with bunks around all four walls and a stove in the center, with toilets and closets in rounded recesses on three sides. Ealing is building 48-person shelters in four 12'6" by 5'3" units arranged in a line end-to-end with the entrances between them. In St. Pancras, 24-person shelters are heated by electric heaters with warm air entering near the floor at one end leaving through ventilators in the roof. There are electric lights, with dim night bulbs. These are all surface shelters.



Supporting floor above shelter in a 7' basement, with beams and struts of steel and of timber. (England)

In surface or semi-buried shelters little attempt is made to make the roof bomb-proof; if a bomb strikes the roof it will pierce any practicable construction; and if it strikes near it, the resulting projectiles will fly at an angle above the horizontal or, in the downward part of their path, will have lost much of their velocity. Some cities have made really bomb-proof shelters by tunneling deep under the ground, or using tunnels already existing, such as coal mines. Newcastle-on-Tyne provided protection for 20,000 in 2½ miles of mine at no place less than 50 ft. below the surface, to which 18 ramp entrances were driven from various points in the city. Ramsgate constructed 2 miles of 6 ft. by 7 ft. tunnel connected to ¾ mile of disused railway tunnel, to which are provided 23 entrances and 10 air shafts. At Southgate, 7 ft. tunnels have been driven into hills. Several cities in this country have such ready-made underground shelters—coal mines, salt mines, etc. British authorities say that 60 ft. of cover is desirable, but 40 ft. may be adequate if the cover consists of sound and homogeneous rock.

The following extracts from a bulletin of the British Ministry of Home Security give some results of experience in that country:

Experience has shown that in the ground floors of ordinary dwelling-houses with normal wooden joist and boarded floors, debris from the upper part of the house rarely comes crashing through ceilings or brings the ceiling down as a whole.

A direct hit by even a small H.E. bomb usually demolishes the greater portion of the average small house; but for every direct hit, many bombs fall near

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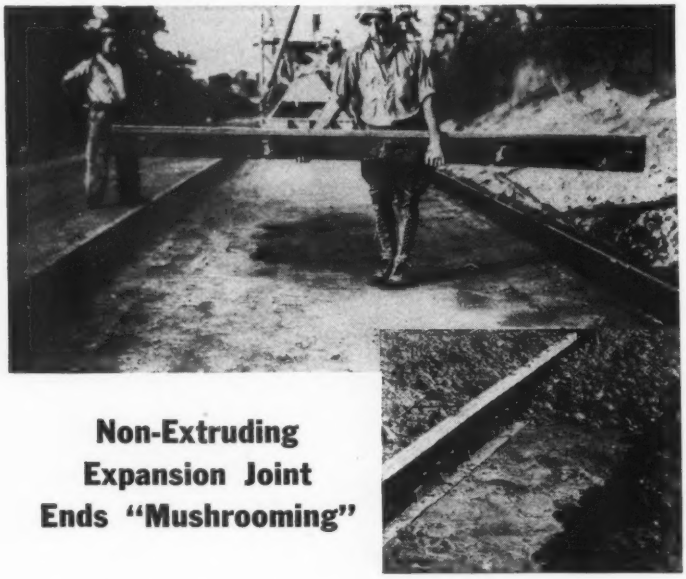

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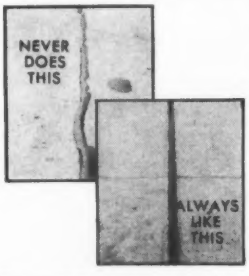

Photographs above show how easily Flexcell Expansion Joint is handled on New York State highway job near Seneca Falls, N. Y.

*The word Flexcell is a brand name identifying a cane fibre expansion joint marketed by The Celotex Corporation.

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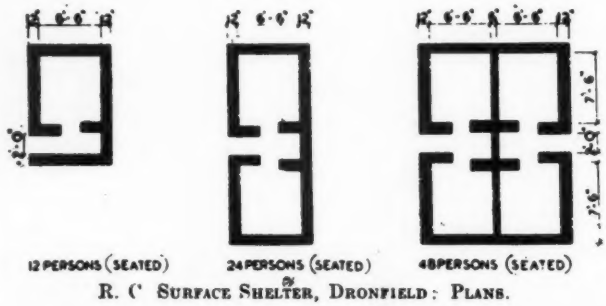
enough to cause severe structural damage. If the wooden joists of the ceiling above the ground floor rest on a wall which is shaken down, the ceiling is deprived of its support along at least one edge, and so tends to fall into the room below. But as the floor boarding is well nailed to the joists, the whole ceiling (apart from the plaster, which, of course, will crack off and fall in flakes), remains joined together in more or less one flat piece, and the complete unit either sags or falls, hinging about the other ends of the joists where they bear on the opposite wall, unless this has also been shaken down by the earth shock.

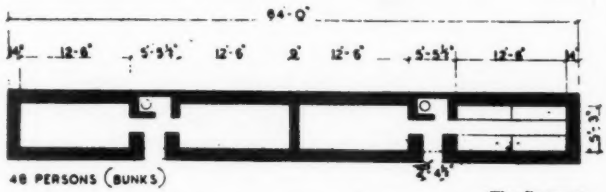
The primary function of an indoor ground-floor shelter is, therefore, to protect the occupants from being crushed by the falling ceiling, and the shelter should be designed accordingly.

The secondary functions are: (1) To protect the occupants from falling debris arising from within the room, such as the upper parts of walls or chimney breast.

(2) To prevent the occupants of the shelter from rising above window-sill level, so that they remain reasonably protected from bomb splinters by the existing walls of the room. Hence the top of the shelter should not be more than about 3 ft. above floor level.



R. C. SURFACE SHELTER, DRONFIELD: PLANS.



The Surveyor

Reinforced concrete shelters being built at Dronfield and at Ealing, showing two methods of arranging units.

(3) To protect the occupants from debris moving laterally, such as (*a*) Debris from collapsing walls. As a rule this does not fly about, but subsides into a heap. (*b*) Debris flung from the bomb crater through the window. If such debris is traveling fast, it will miss the shelter. (*c*) Debris set in motion by blast; anything with a large rigid surface area but of comparatively light weight, such as doors, partition walls, furniture, etc., may be wrenched from their fixings (if any) and flung violently against the shelter.

An indoor shelter should possess as many as possible of the following features:

(1) The shelter should be placed clear of walls, so as to facilitate emergency exit or rescue of the occupants.

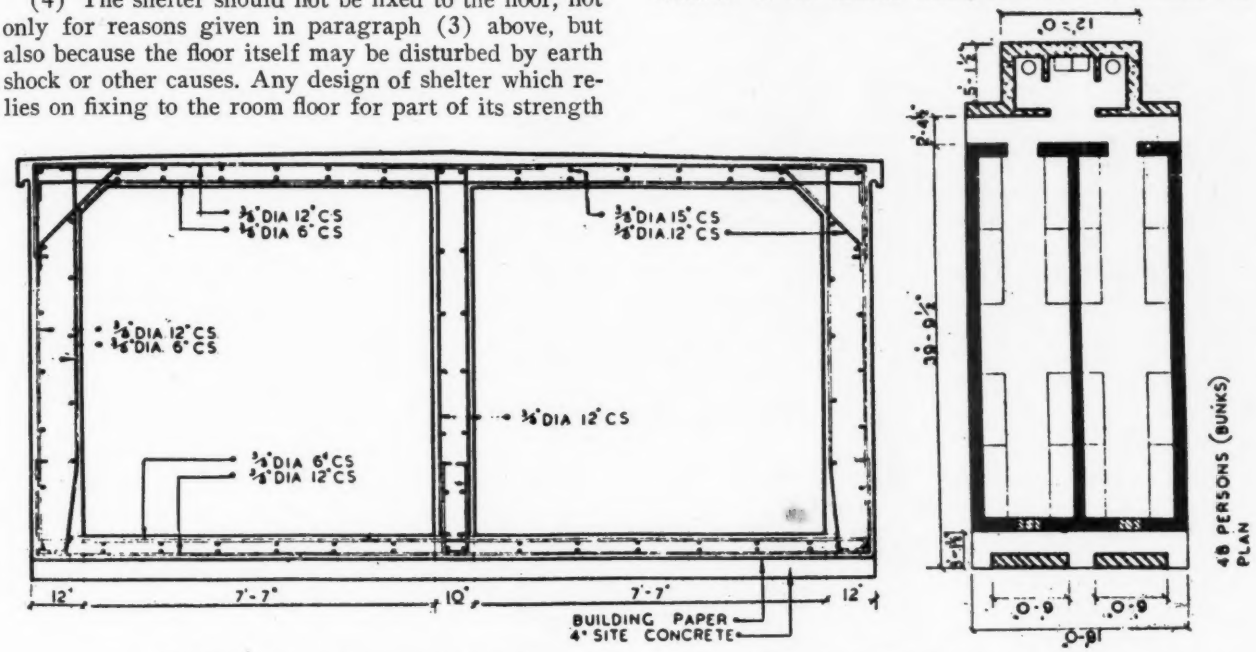
(2) The best advantage should be taken of the existing splinter protection by avoiding positions vulnerable to splinters entering through weak places, such as in a straight line through an outside door and the room door.

(3) Shelters, other than the massive type, should be movable, like a piece of furniture, not only for the con-

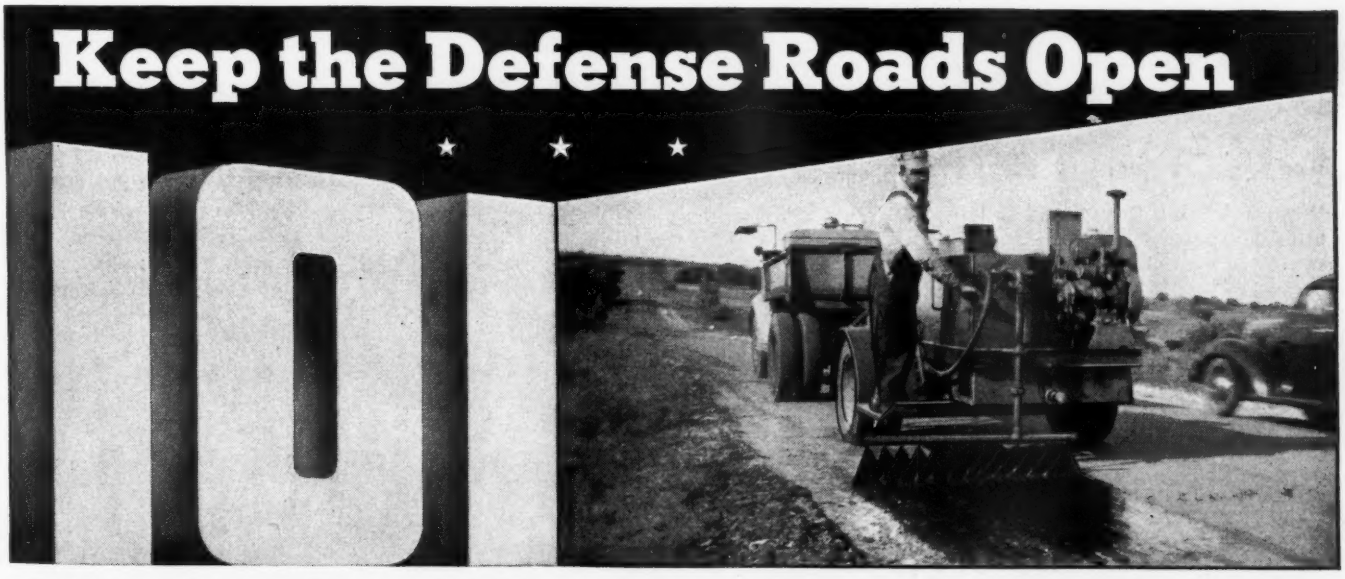
venience of the householder, but because, if the shelter is struck by the ceiling falling at an angle (which is usual), or by lateral debris, the shelter will tend to move; and if it does move the effect of the impact on the shelter will be less, owing to absorption of energy in moving the shelter.

(4) The shelter should not be fixed to the floor, not only for reasons given in paragraph (3) above, but also because the floor itself may be disturbed by earth shock or other causes. Any design of shelter which relies on fixing to the room floor for part of its strength or stability is undesirable because, even if the floor is not seriously disturbed by earth shock, etc., the floor units may give way when the shelter receives a blow, especially if the floor timber is weak owing to age or decay.

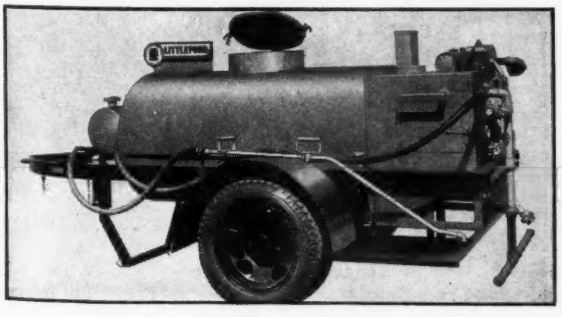
(5) The shelter should have its own floor, securely attached to the shelter walls, so that if the shelter is



Reinforced concrete surface shelters being built at Cardiff. Plan shows twin box construction with 8 tiers of bunks in each compartment. Toilets in entrance-protecting structure. The Surveyor



UTILITY SPRAY TANK



Now is the time to get our roads in tip top shape. The Littleford No. 101 Utility Spray Tank is just the unit to do the work. Has facilities for doing three jobs—Has Spray Bar for small application work, Hand Spray Attachment for patch work, and Draw-Off Cock for crack filling. Keep our Defense Roads open with Littleford Road Maintenance and Construction Equipment.

BLACK TOP ROAD MAINTENANCE EQUIPMENT — LB — SINCE 1900

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When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 55-57

moved suddenly, or overturned, the occupants will move with the shelter, and thus be less likely to sustain serious injury.

(6) Bearing in mind the limited space and the small size of rooms in the average house, the shelter should have a secondary use. Thus, a shelter with a flat top could be used as a table.

(7) For the same reason, the shelter should cut off as little light as possible from the rest of the room. Open mesh construction at the sides and ends is advantageous in this respect as it is, also, in the interests of hygiene, for it provides for maximum ventilation.

(8) Easy access to the inside of the shelter is of importance for convenience in making up bedding; but easy exit is of paramount importance. Hence, designs which permit exit from the ends only are inferior to those which facilitate exit from the sides as well. It will be appreciated that, with the shelter buried under a heap of debris and the air heavily charged with dust and escaping gas, as many exits as possible are highly desirable, each being easily and rapidly opened either by the occupants from within, or by rescuers from without. Under such conditions every additional exit increases the chances of escape.

Miscellaneous Suggestions

For shoring up ceilings, struts with jacks at the end, similar to long trench braces, are convenient. Corrugated steel plates, supported by struts or posts under ceilings, will prevent falling of ceilings. Close wire mesh in frames fastened to the window frames will do much to prevent flying glass. For large first-floor windows, a wall of sand bags a few feet in front of a window affords considerable protection. It is desirable to confine this between two walls of plank or of chicken wire covered with an inch of gunite, to prevent escape of the sand from broken bags. San Francisco fills bags to 60% of their capacity with sand heated and mixed with 3% of 60 penetration paving asphalt, putting the bags in place while warm and ramming them flat; the sand does not run out should the bags rot or be torn away.

If window panes are broken, they may be replaced with wire glass or with glass substitutes, preventing flying splinters in future blasts. Damp-proofing concrete walls underground is desirable. So are portable pumps for use should a shelter be flooded, as by a broken water pipe.

Other miscellaneous materials and appliances useful in air raid defense, not mentioned above, include: air compressors with tools; chemical toilets; chemicals for waterproofing bags; glass brick, sidewalk lenses, etc.; electric heaters; hose for pumps; interlocking blocks (concrete or vitrified clay); light generating sets; portable spraying pumps; corrugated steel arches; quick-setting cement; reinforced concrete tubular shelters; reinforcement of all kinds; sand bag loaders; scaffolding posts (shoring up basements); sound insulation; synthetic glass, translucent, unshatterable; ventilating fans; wall boards of various types.

An English engineer says: "I suppose at least 75% of damp shelter cases are due to condensation. . . . If the condensation is slight, the walls and ceiling can be treated with cork dust. If it is severe, a more expensive cure should be employed, and I would suggest that the walls and ceiling are battened and counter-battened and covered with some form of fibre-boarding, care being taken to see that the battens nearest the walls are vertical, in order to prevent the moisture being carried to the fibre-boarding, and that there is a cavity as large as possible between the wall and the boarding.

GALION READY TO TAKE THE OFFENSIVE IN ROAD BUILDING

We are in this thing to a finish now . . . we've really a job to do and it's all out for Victory . . . full speed ahead . . . staying in there and pitching . . . every day—every week.

A heavy contributor on defense projects in the past, Galion is ready to take the offensive so we can keep 'em flying . . . keep 'em moving. More and better roads are important and Galion road machinery . . . graders, rollers and spreaders . . . has brought and will bring many of these jobs to successful completion . . . in record time.

GRADER	No. 101		No. 201	
Motor H. P.	*Gasoline 64*	*Diesel 68½*	*Gasoline 46*	*Diesel 50*
Weight* single drive	19,800	20,800	15,100	15,600
Weight* double drive			17,400	17,900
Length	25′ 2″	25′ 2″	25′ 2″	25′ 2″
Blade length	12′	12′	12′	12′
Frame wgt. per ft. lbs.	92	92	84	84
Reversible	Yes	Yes	Yes	Yes
Bulletin	No. 253		No. 254	

**Less Scarifier*

Centralized finger-tip controls, including steering
All-gear driven double drive
Full revolving circle
Leaning front wheels
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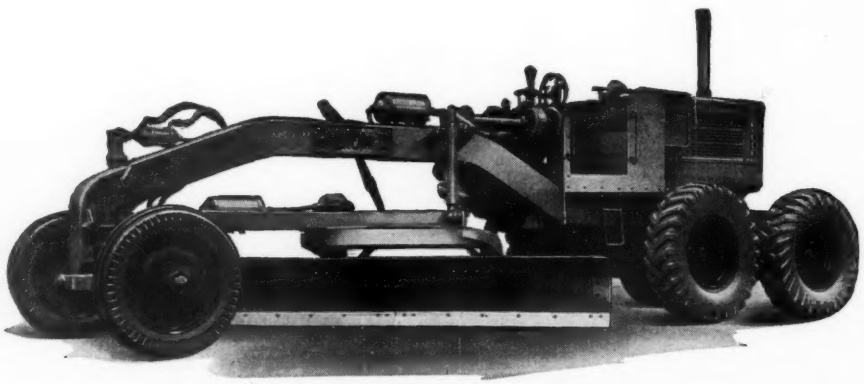
One-piece narrow box-type frame



Galion No. 101 and 201 motor graders are identical except for power, weight and wheel equipment. Use the chart at left for your grader calendar for 1942. Additional data upon request. In addition to these two heavy duty graders, Galion builds the light weight No. 401 for general maintenance, covered by Bulletin No. 254.

THE GALION IRON WORKS & MFG. CO., GALION, OHIO

Apart from the natural absorption of the fibre-boarding, this cavity will provide a buffer temperature and thereby cause a reduction of the amount of condensation. Any decorative treatment to the boarding should consist of a water-paint or stain, and not paint or distemper. Another, and cheaper, method of counteracting the natural condensation on the walls is to form a pervious surface by lining them with 2-in. breeze blocks, making the joints as thin as possible and leaving the face of the breeze blocks untreated and a cavity of about 2 in. between the walls."

Protecting and Repairing Municipal Services in Wartime

(Continued from page 20)

Emergency Chlorination

Every break must be chlorinated as soon as repaired. There are basically two methods of emergency chlorination, one to use chlorine gas directly, and the other a chlorine-releasing solution such as HTH, Perchloron, or hypochlorite. Each method has its advantages.

Several American manufacturers have developed portable equipment mounted on a trailer, complete for sterilizing mains, and smaller outfits that can be placed on a truck or carried by two men.

One type uses a pump which injects a solution directly into the main against the pressure. Such a unit weighs 150 lbs., can be operated by electricity or an emergency gasoline unit, and has a capacity of 100 lbs. per day at 175 p.s.i. It is extremely mobile. In emergency it can be transported even in the trunk-space of the car.

If the mains have sufficient pressure, the chlorination unit can be attached without a pressure pump, utilizing the differential pressure before and after a partly throttled valve.

Fig. 22—Portable solution feeder for chlorinating mains can be carried in trunk of a car. (%Proportioneers%)

The advantages of the solution feeder type are: injection is made directly into pressure line, without any by-passing; operation by semi-skilled personnel; ease of handling material; no danger of liquid chlorine gas, if damaged by fragments.

The second method uses liquid chlorine. Wallace & Tiernan makes a unit mounted on a trailer, which weighs about 2150 lbs. and has a normal capacity of 100 lbs. chlorine per day at 100 p.s.i. pressure. The trailer has a special frame to protect it from damage if overturned.

EMERGENCY STERILIZATION *ANYWHERE*

You can be prepared quickly IF YOU ACT NOW!

Investigate %Proportioneers% Dual Drive (gasoline engine or electric motor) Emergency Chlor-O-Feeders for:

EMERGENCY CHLORINATION—to sterilize breaks, new mains, dead ends, floating reservoirs, and remote sections.

STANDBY CHLORINATION—to augment gas chlorinators during emergency overload periods or to replace them during repairs.

% PROPORTIONEERS % ***Dual Drive Emergency Chlor-O-Feeder is the only moderately priced unit giving you these important advantages:***

1. **Feeds over 100 lbs. chlorine per day.**
2. **Any pressure up to 175 lbs.—*no booster pump required.***
3. **Portable, light, easy to handle—see photos.**
4. **Feeds any water works chemical.**

Dual Drive Chlor-O-Feeders provide complete chemical feeding emergency protection for water works. Don't put all your eggs in one, *expensive* basket; have *several* of these versatile emergency chlorinators on hand. Act now while there is time.

Manufacturers of hypochlorite and priority rulings of O.P.M. indicate that hypo *will continue to be available,* for safeguarding public health, under A-2 preference rating, order M-19, in either liquid or powder form.

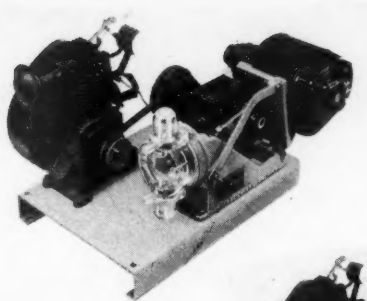


Fig. 1—Heavy Duty Dual Drive Chlor-O-Feeder for pressures up to 85 lbs.
Price **$330.00** *delivered to your plant, express prepaid.*

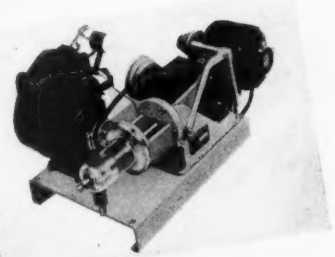


Fig. 2 — High Pressure Unit for pressures up to 175 lbs.

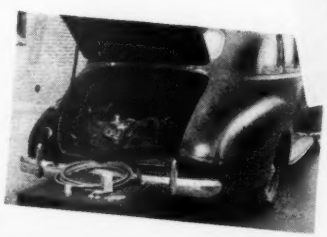


Fig. 3—Portable Emergency Unit fits easily in trunk of car.

WRITE "Emergency Chemical Feeder Headquarters" TODAY

% PROPORTIONEERS, INC. %

96 CODDING STREET PROVIDENCE, R. I.

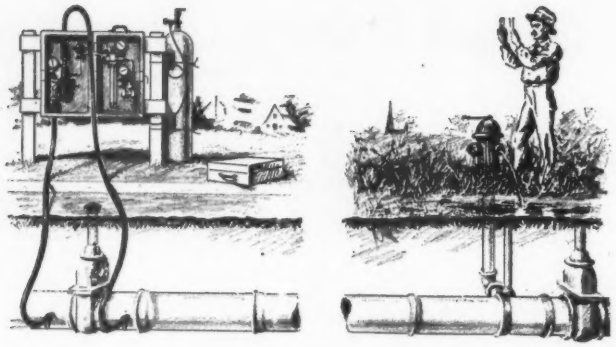


Fig. 23—How a main under pressure can be chlorinated without use of a pump.

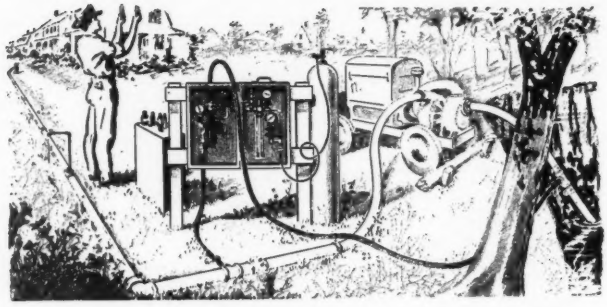


Fig. 24—Equipment for chlorinating an emergency supply. (Figs. 23 and 24 courtesy Wallace & Tiernan)

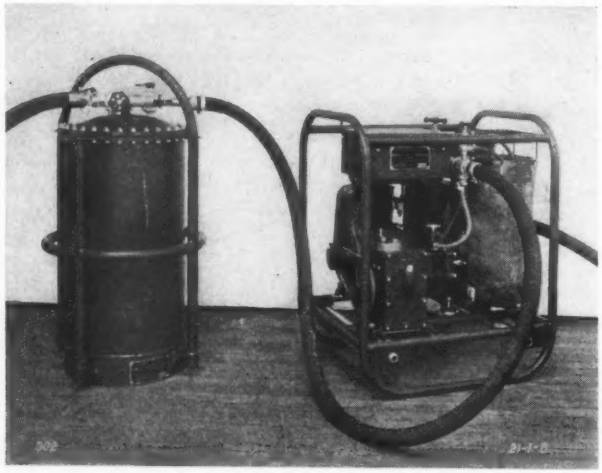


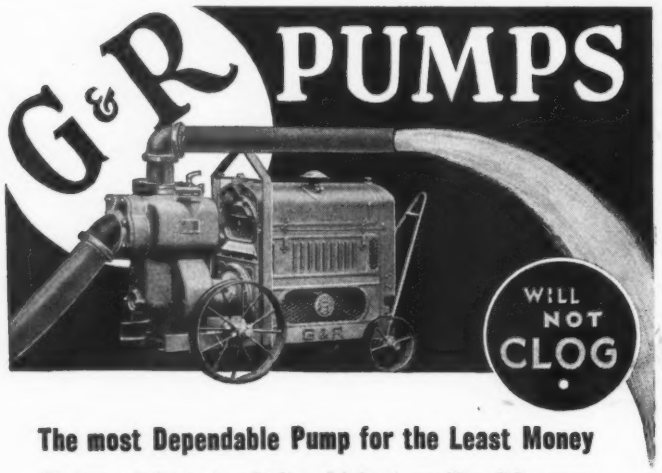
Fig. 25—Portable filter-chlorinator unit, U. S. Army model. (Courtesy Wallace & Tiernan)

For a description of English practice in restoring bombed mains to service, see PUBLIC WORKS for April, 1941. For American practice in sterilizing mains, see PUBLIC WORKS for May, 1941, and June, 1939.

Individual Treatment

In an extreme emergency, when all services in an area fail to function, the problem arises of how to provide the population with water. The public should immediately be informed by radio, newspapers, street loudspeakers, placards or other convenient means of the existence of an emergency. If the supply is intermittent, water can be stored in various containers. If necessary, orders for boiling should be issued. However, if the gas mains are also disrupted and boiling is impossible where gas is used for cooking, everyone will have to treat his own water.

A simple method is to prepare a disinfection solu-



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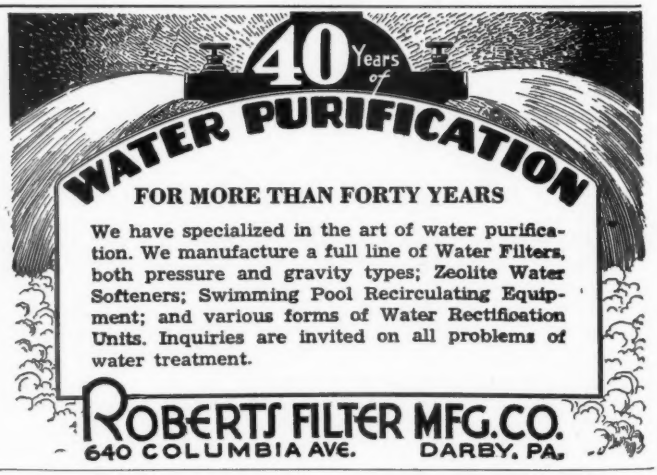
Claims of fastest priming, highest suction lift, more gallons per minute, etc., do not pump water. On the job, the pump must do its own talking, and with dirty water, many a pump is inclined to stutter—and stop.

Let G & R Pumps tell you their own story on any job. They will deliver as much, and usually more, water under any condition, than any other pump. We will ship you one and let you be the judge.

Remember this about G & R Pumps—THEY WILL NOT CLOG—THEY ASK NO TIME OUT. Play safe! That is why more contractors are standardizing on G & R Pumps than on any other make.

Distributors in 100 principal cities are ready to make prompt delivery of the G & R Pumps you need.

THE GORMAN-RUPP CO. Mansfield, Ohio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We have specialized in the art of water purification. We manufacture a full line of Water Filters, both pressure and gravity types; Zeolite Water Softeners; Swimming Pool Recirculating Equipment; and various forms of Water Rectification Units. Inquiries are invited on all problems of water treatment.
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tion in a carboy and add this solution to the water. A teaspoon of chloride of lime (20% to 25% available chlorine) per quart will give a good solution. A teaspoon of this solution, if added to a gallon of water, will disinfect it to the extent of 1 p.p.m. Other types of disinfectant can be used in a similar way. Any excess of chlorine can be absorbed by filtering the water through activated carbon. A carbon filter is likewise effective in removing mustard gas.

Serious consideration should be given to the adoption of overchlorination of water as protection against sabotage activity; the population being warned not to use water which does not have a distinct chlorine smell. This water coming from the faucet could then be filtered to make it more palatable. In Germany and Lithuania a part of the population was supplied with individual filters which could be fitted over faucets.

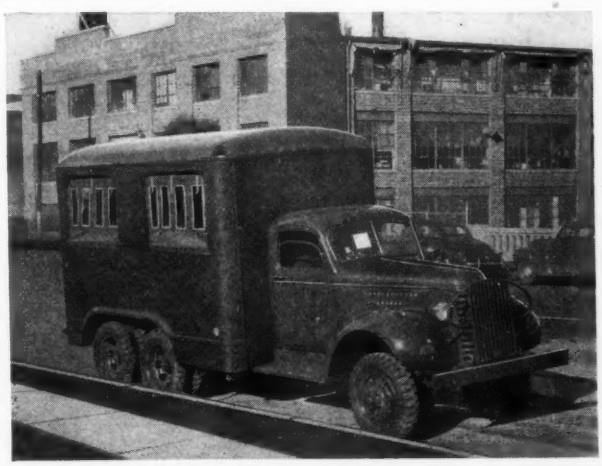


Fig. 26—Mobile water purification unit, U. S. Army, model of 1938. (Wallace & Tiernan)

Where, in England, it required many hours or even days to repair broken mains and bring water to a bombed area through them, water has been distributed from house to house in tanks. Street sprinkling or flushing trucks can be used for this purpose.

Supplying the Evacuees

If it should become necessary to evacuate large numbers of people from cities, provision will have to be made for supplying them with water, if they are established in camps, or for increasing the supply of the community receiving them. This supply may have to be obtained from a polluted or doubtful source, in which case it should be chlorinated, and possibly filtered also. Units for this purpose have been designed by the army engineers in cooperation with manufacturers of chlorination equipment. The unit shown (Fig. 25) has a capacity of 100 gal. per min. for a turbidity of 100 p.p.m. at 90 ft. total head, 20 ft. of which is suction lift. It is equipped for treatment with chlorine, alum and soda ash.

Chlorine to Be Available for Water and Sewage Treatment

Necessary amounts of chlorine for water purification will be provided throughout the nation despite the general chlorine shortage, the Chemicals and Allied Products Branch of the War Production Board announced on January 27th.

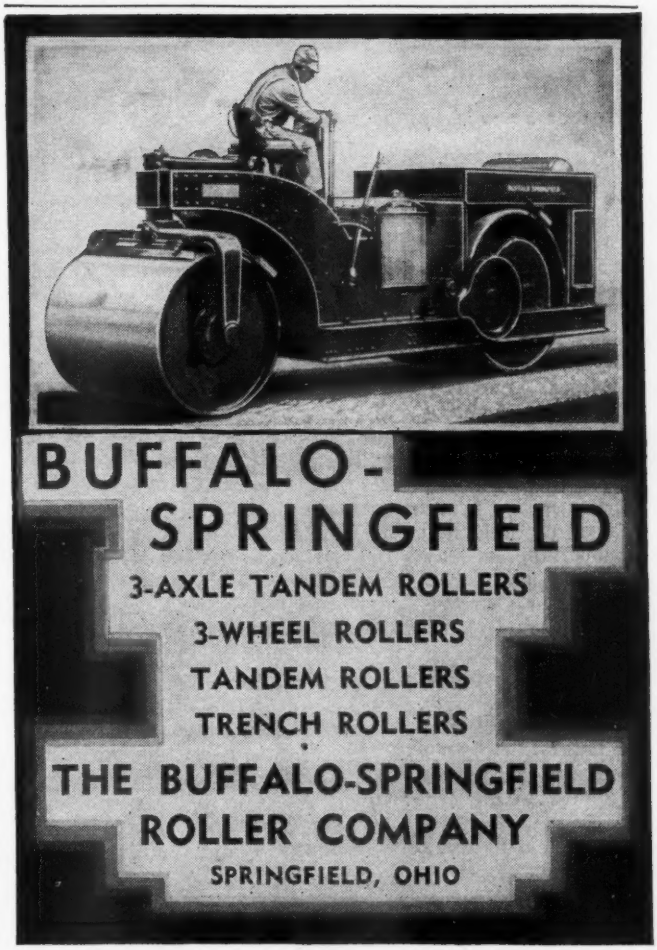
While chlorine is one of the most widely used chemicals in war manufacture, and many restrictions on civilian use have been necessary, water treatment, according to the announcement, will not be one of them. Chlorine in all forms for potable water and sewage treatment is given a high preference over civilian and some war uses. This preference will permit water and sewage plants to obtain necessary supplies of chlorine and sodium hypochlorite.

Sanitary Corps, U. S. Army Seeks 80 Engineers

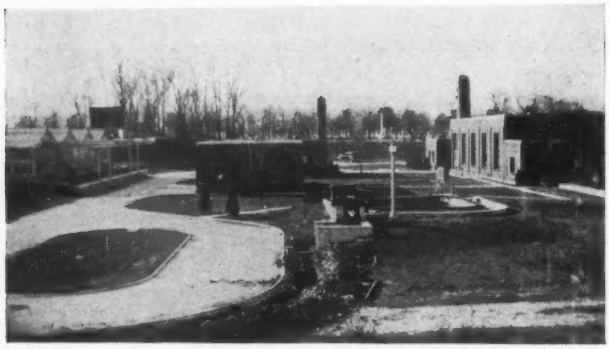
The Sanitary Corps, Army of the United States is seeking eighty qualified civil or sanitary engineers to be commissioned as 1st Lieutenants in the Sanitary Corps, according to a report just received from Captain J. J. Gilbert. The applicants should be under thirty-seven years of age and physically qualified in accordance with Army regulations. The commissions will be granted for the duration of the present emergency and a period of six months thereafter. Applicants must have had at least your years actual experience in sanitary and public health engineering, including two of the following: mosquito control, rodent control, water supply, sewage treatment. No military knowledge is required.

The base pay of 1st Lieutenant is $2,000 per year plus allowance of $18.00 per month for subsistence and $40.00 per month for rental, if single, or plus $36.00 per month for subsistence and $60.00 per month for rental, if married.

Any qualified engineer who desires a commission in the Sanitary Corps should write to the Surgeon General, U. S. Army, Washington, D. C., giving a complete statement as to age, educational and experience qualifications together with a complete summary of duties performed under each position held.



When writing, we will appreciate your mentioning PUBLIC WORKS



General view of Findlay, Ohio, plant. Main building at right; sludge beds and digester at left.

The Sewerage Digest

Abstracts of the main features of all important articles dealing with sewerage and sewage treatment that appeared in the previous month's periodicals.

Suggestions for Sludge Pumping

Plunger pumps will pump mixtures of sludges, sewage gases and air equally as well as liquids; but are often noisy, are subject to slippage, and the packing and valves give trouble if not kept adjusted and renewed when necessary. Centrifugal pumps perform best under positive suction head; they are clean and quiet in operation and have no valves to need attention. Positive suction head is desirable, regardless of the type of pump. The suction line should be as short as possible; no part of it should be higher than the point where it enters the pump; the number of bends should be a minimum. The suction inlet end should be located on the side of the sludge well. Foot valves, float valves and check valves should never be used on the suction side of the pump. A combination vacuum and pressure gauge should be provided on the suction side of the pump and a pressure gauge on the discharge side. Check valves should be so located that, when the pump is shut down, sludge solids will not settle on the flapper. Both suction and discharge pipes are often too large—they should be small enough to give a velocity through them of not less than 1 fps when the pump is operating at normal capacity. [G3*]

Performance Test of Sewage Pumps

Louisville, Ky., installed in its sewage pumping station a 48″, a 36″ and a 16″ pump. In the discharge line of each of these is an automatic cone valve which acts as a check valve and also as shut-off valve; remaining closed when the pump is not running, opening automatically when the pump is up to speed, and closing automatically when the current is off the motor. The valve is operated by water pressure controlled by a solenoid-operated valve. Starting and stopping of the pumps is controlled automatically by float switches. The pumps are below sewage level and therefore always primed. To keep down the "demand" charge for current, it was made impossible to operate any two pumps at the same time. The pumps were tested rigidly for general fitness, automatic operation, rotation in reverse, and other features, including ability to pass solids and capacity at different heads. Wooden spheres were passed through the pumps, 8″ through the 48″ pump, 6″ through the 36″ and 16″. All spheres passed but some were broken. Also 5 bu. of chips and blocks were placed in the pump suction, and 10 to 20 lb. of rags, and passed through readily. All the pumps met or exceeded the guarantees. [L1]

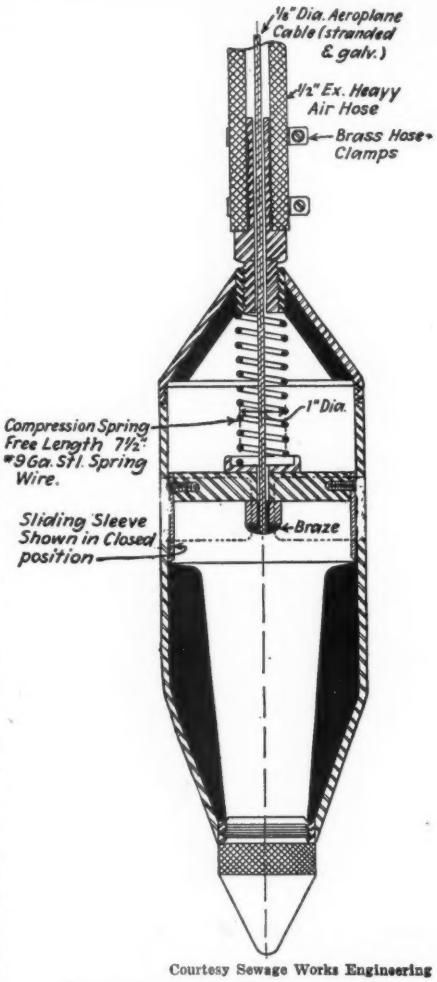
War-Time Disposal in England

The Ministry of Health permits construction of treatment works where there is danger of pollution of water supplies but not merely to prevent lowering the standard of purity of rivers. If necessary, many plants could deal with a little more sewage by practicing optimum frequency of cleaning of tanks and optimum depth of sludge on beds. Clinker and other materials for filters are getting scarce and use of broken bricks, etc., from bombed buildings is suggested.

Preparation should be made for post-war work. There will be plenty to do, but it is not sufficient merely to think "my works are overloaded and will require extension after the war," but it is desirable to consider the extent of enlargement required, the individual units requiring attention and the most suitable position for the new works. Where detailed plans had been prepared for schemes abandoned because of the war, see that these are in shape for immediate use.[D3]

Inventorying Digestion Tanks

At the Buffalo, N. Y., treatment works, inventories of the contents of the four digestion tanks are taken monthly. Each tank is 90 ft. diam., 27 ft. at the side and 38 ft. at the center, with floating covers. Each tank is fed for an 8-hr. period on a 32-hr. cycle. The detention period is roughly 30 to 35 days. Sludge inventories are taken once a month, samples being taken at 2 ft.-depth intervals, through three openings in the floating cover 8.5 ft., 20.5 ft. and 33.5 ft. respectively from the circumference. The sampling device is a cylinder with cone-shaped ends and weighted at the bottom, with three ports in the cylindrical side closed with a sliding inside cylindrical ring that is held down with a spring but can be raised, when the device is at sampling depth, by a ⅛ in. cable that passes up through a ½ in. rubber hose by which the

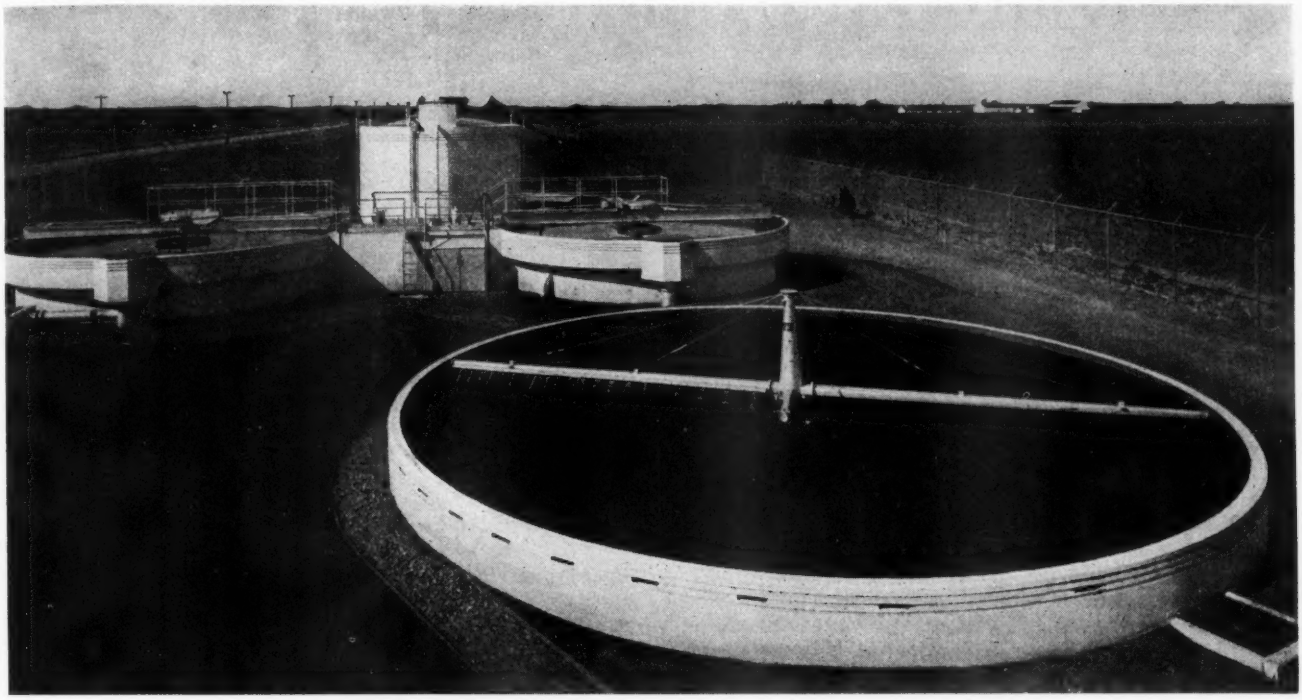

⅛" Dia. Aeroplane Cable (stranded & galv.)
½" Ex. Heavy Air Hose
Brass Hose Clamps
1" Dia.
Compression Spring Free Length 7½" #9 Ga. St. Spring Wire.
Sliding Sleeve Shown in Closed position
Braze

Courtesy Sewage Works Engineering

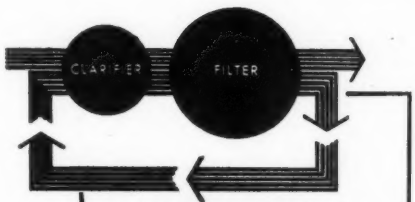
Sectional assembly of sludge sampler.

*See Bibliography in the January issue.

WHY RECIRCULATION AND LONGER DETENTION IN BIOFILTRATION SYSTEMS



A single stage Biofilter plant serving the 3000 inmates of a state institution.



COMPARATIVE B.O.D. REDUCTIONS
With and Without Recirculation

	Without Recirculation	With Recirculation
Single Stage		
Infl.—B.O.D. P.P.M.	774	644
Effl.—B.O.D. P.P.M.	169	53
B.O.D. Reduction—Percent	78.1%	91.8%
Two Stage		
	With Recirculation	
Infl.—B.O.D., P.P.M.		576
Effl.—B.O.D., P.P.M.		14
B.O.D. Reduction—Percent		97.6%

Above runs made at Petaluma, Cal. 5 days duration each. 24 hr. composite samples.

The Biofiltration System is an oxidation system. As in all oxidation systems, B.O.D. reductions are a function of detention—of time of contact.

That's why trickling filter effluent is recycled back to the primary clarifier. That's why the primary clarifier is larger than for a straight trickling filter plant of the conventional type.

Does the added cost of recirculating pumps pay off? Is the larger primary clarifier justified? Definitely yes on both counts as the table at the left shows.

The higher the rate of recirculation the higher the B.O.D. removals. That's why, on a normal sewage, a single stage Biofilter shows 85-90 percent B.O.D. reduction and a final effluent of 30 or less P.P.M.—why two stages of Biofilters show reductions of 90-95 percent and effluents of 20 or less P.P.M.

This is further explained in our bulletin on the Biofiltration System. A copy is yours for the asking.

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sampler is suspended. Each sample is emptied into a pint bottle and testing begun immediately, and results on total solids and volatile matter are available the next morning, and those on pH, volatile acids, pounds of solids and depth of each layer are ready next day. This information helps the operating department to decide whether scum should be pumped and from which tanks, and whether a particular tank has been loaded faster than sludge was removed from it. The inventories show seasonal variations; in summer sludge layers become deeper but thinner in concentration and the top sludge becomes less dense and more plastic. During the summer the temperature of the tank contents varied less than 5° between top and bottom at any time and remained within the range of 82° to 92°; which was true during winter months also except that the top 6 or 8 ft. reached a minimum of about 62° at the top.[H4]

Sewerage Finances at Oshkosh

Oshkosh, Wis., derives funds for operating its sewerage system by a service charge, based on the water bills. This covers cost of operating intercepting sewers, five pumping stations and the treatment plant, maintaining a collection office, and paying interest on and retiring bonds. The depreciation fund is set aside as actual cash. Insurance is carried on plant building and structures in respect to explosion, fire and wind. Some equipment is insured against fire and accidental failure. Sale of sludge for fertilizer offsets cost of removing sludge and maintaining beds and labor on the landscaped grounds. In 1941 fertilizer sales yielded $811.91 and service collections $75,255. Operating, maintenance and admin. expenses totaled $44,025.[H6]

Two-Story Digesters at Ludlow

Two-stage sludge digestion at the Ludlow, Mass., plant designed for 7,000 population, is in two tanks, each having a main roof of 12" of concrete, above which is storage for 3 ft. depth of sludge liquor, which is covered with a second or weather roof. A pneumatic ejector delivers sludge to the center of the primary tank, the primary sludge liquor so displaced passing to the center of the secondary tank, and the secondary sludge liquor is delivered to the storage spaces above the two tanks; overflow from which passes slowly to the influent of the settling tank through a 1" pipe. Gas accumulating below the main tank roofs displaces liquor in them to the storage tanks; and this liquor returns to the main tanks when the volume of stored gas decreases; also when sludge is withdrawn. The stored liquor and the air and roof above it keep the digestion tanks at almost constant temperature.[E7]

Velocity Control In Grit Chambers

To maintain a constant velocity in a grit chamber at all flows, a proportional weir has been designed, which produces a satisfactory velocity control but for proper operation the entire head in the grit chamber must be lost. Parshall and Venturi flumes loose less head and have been used by giving the grit chamber a special shape, but this shape is not economical to build and is not adapted to use of mechanical cleaning machines. The author describes how to design a grit chamber with a rectangular cross section in conjunction with a flume and still obtain a uniform velocity. This consists essentially in determining the relationships so that the straight-line depth vs. cross-sectional area curve of the rectangular grit chamber lies as closely as possible to the depth vs. quantity/velocity curve of the control section, over the range of flows being considered. Two relationships must be considered; first, the ratio of width of the grit chamber to width of the control section which gives the closest average slope of the two curves; second, the relative elevations of the bottoms of the control section and of the grit chamber which result in the closest position of the two curves.[G4]

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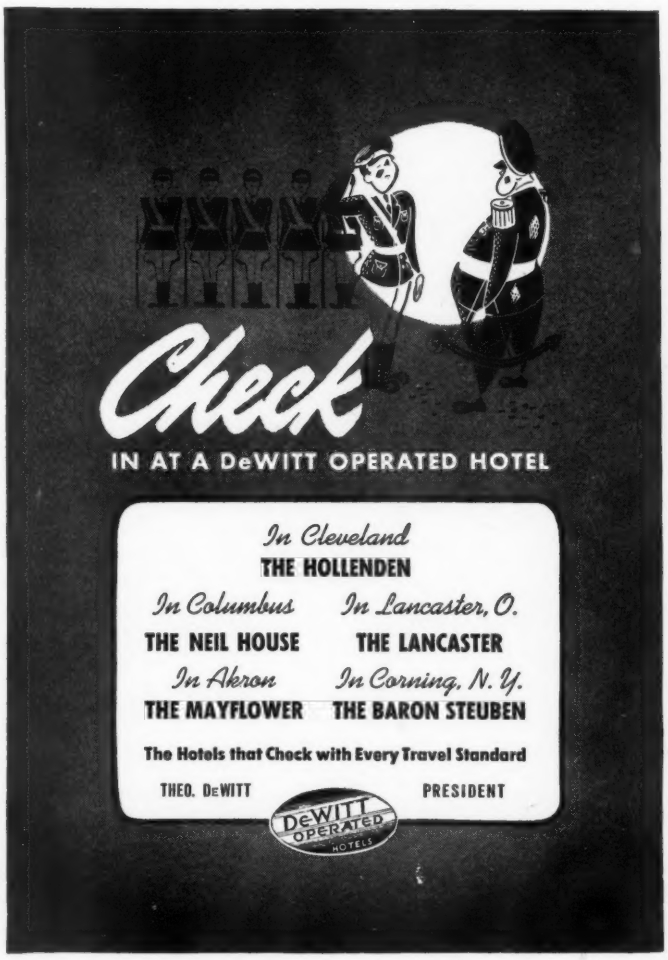

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Digesting Secondary Sludges

Experience and experiments at Halifax (England) with digesting sludges consisting of 3 parts humus mixed with 1 part activated sludge (giving about equal parts of dry solids) led to the following conclusions: Odors were reduced at mesophilic but not at thermophilic temperatures. When warm, the odors of the thermophilically digested sludge were more objectionable than those of the original sludge, and the gases had a foul odor. Digestion of this sludge at low temperatures requires a longer time and larger tank capacity than does primary tank sludge.

The thermophilically digested sludges are not amenable to dewatering by mechanical means. Drying on sludge filter beds of this material, digested at atmospheric temperatures, is slow and no improvement over that of the undigested sludge, it being possible to dry to 70% moisture content not over 3 ft. total depth of sludge per annum. The amount handled by the beds can be increased by addition of ferric sulphate, but this would not normally be an economical procedure except in case of winter difficulties.

More attractive than the above procedure, both technically and economically, was heat treatment followed by pressing and disposal as fertilizer, and this process was selected as the solution of this problem.[D4]

Bibliography of Sewerage Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

D *The Surveyor*

November 21

1. Sewerage and Sewage Disposal Problems of Small Communities. By H. D. Hargreaves. P. 170.
2. Renewals of Sewage Sprinkler Arms. By C. L. Gregson. P. 174.

November 28

3. *p*. Sewage Disposal and Drainage in War Time. By J. T. Calvert. P. 181.

December 5

4. *p*. Investigations Into the Digestion and Drying of Humus and Activated Sludges. By C. Lumb. Pp. 191-192.

December 12

5. Alternating Double Filtration for Treating Sewage and Trade Effluents. P. 199.
6. Sewage Works Operation in War Time. Discussion of D3. Pp. 201-202.

G *Water Works & Sewerage*

December

4. Improved Method of Velocity Control in Grit Chambers. By R. J. Bushee. Pp. 561-563.
5. Effluent Excellence. By E. B. Mallory. Pp. 564-565.

H *Sewage Works Engineering*

December

3. Practical Design Features of Sewage Pumps. By H. J. Meeker. Pp. 636-640.
4. Inventorying Sludge Digestion Tanks at Buffalo. By G. E. Symons. Pp. 641-644.
5. Peach Wastes Produce 7 cu. ft. of Gas Per Pound. By J. B. Wirt. Pp. 647-648.
6. Finances of Oshkosh Treatment Plant. Pp. 648-650.

January

7. Supernatant Stored Above Sludge in Two-Storied Digesters. By H. W. Taylor. Pp. 8-9.
8. Installation and Maintenance of Motors and Controls. By H. V. Crawford. Pp. 10-14.
9. Excess Sludge Gas for Motor Truck Fuel. Pp. 15-17.
10. Activated Sludge Treatment for 1600 Persons. By C. H. Ellis. Pp. 18, 26.
11. Pickle Liquor Causes Corrosion at Treatment Plant. Pp. 24-26.

J *American City*

January

2. No Waste Gas at Fargo, N. D., Sewage Works. Pp. 62, 63, 78.

L *Civil Engineering*

December

1. Performance Tests of Large Pumping Plant. (Louisville sewage plant.) By C. F. Johnson. Pp. 703-706.
2. Flexible Sewage Treatment for Army Camps. By R. Eliassen. Pp. 707-710.
3. Controlling Pollution of Oyster-Growing Waters of Chesepeake Bay. By G. L. Hale. Pp. 715-717.

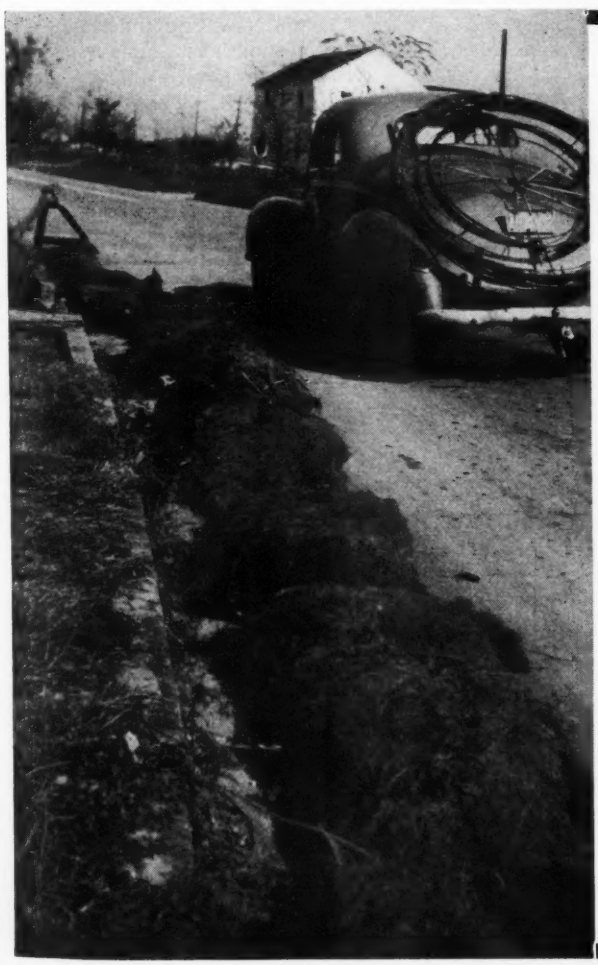
January

4. New Sanitary Sewage Facilities for San Diego. By B. D. Phelps and R. C. Stockman. Pp. 17-20.

P *Public Works*

January

4. Army Sewage Treatment Plants: Camp Edwards. Pp. 11-12, 18.
5. *p*. Operating Results in Lansing's Combined Garbage-Sewage Disposal. Pp. 24-26.
6. Third Year of Sewage Treatment Operation at Buffalo, N. Y. By C. R. Velzy, J. W. Johnson and G. E. Symons. Pp. 27-28. 50.



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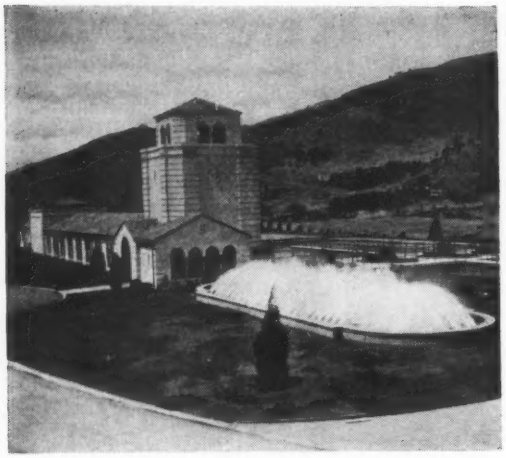


The Waterworks Digest

Abstracts of the main features of all important articles dealing with waterworks and water purification that appeared in the previous month's periodicals.

Silting of Storage Reservoirs

There are about 6,650 dams in Pennsylvania, 465 of them creating large storage reservoirs and estimated to have cost $63,000,000, which value is destroyed in proportion to the amount of diminution of storage capacity by silting. If the capacity is diminished by more than 1% annually, immediate attention is demanded. If a reservoir has storage of less than 50 acre-feet per sq. mi. of drainage area, and this area is more than 10% farm land or shows serious erosion of stream banks or elsewhere, then a study of silting conditions is warranted.

To prevent silting before the reservoir is built, select a watershed with forest or grass covering, or build a reservoir so large that the rate of sediment will cause only a small fraction of 1% storage loss annually. To decrease silting in an existing reservoir, develop a plan of water release at dam to carry out the sediment; or erosion-control measures on the drainage area; as by planting trees (Pennsylvania water companies planted 714,500 trees in the spring of 1941), or build check dams in gullies or protect stream banks. Soil conservation, which aid farmers as well, is effected by crop rotation, plowing on the contour, terracing, strip cropping, development of vegetated field drainage ways, check dams, reforestation and fire protection, and grazing control. X2*

Building Waterworks By Force Account

Oklahoma City opened bids in July 1941 for a 48" conduit and 27 miles of mains, and awarded a contract which was $350,000 above the engineers' estimates. Bids received for building an earth dam for a 25-billion gallon reservoir were $858,000 above the estimates. City Manager H. E. Bailey estimated that this was equivalent to 49.8 cts. a cu. yd. for earth handling and that it could be done by the city for 30 cts., and he was directed to do this work by force account with full power to hire and fire. Earth handling equipment guaranteed to move 20,000 cu. yd. daily was hired for $477,000, with contract to maintain it for $145,000 additional, totaling 15 cts. per cu. yd., leaving 15 cts. of the estimated cost for fuel, labor and overhead. Later, saying that the city would contract for the rest of the work if reasonable bids were received, it received a bid for concrete in bridges, spillway, inlet tower, etc. at $16.50 a cu. yd. It was estimated that it would cost the city $14 by force account and, considering the $2.50 a legitimate profit, the contract was awarded. Other work in the project includes a 40 mgd filtration plant and a 65 mgd pumping plant. J1*

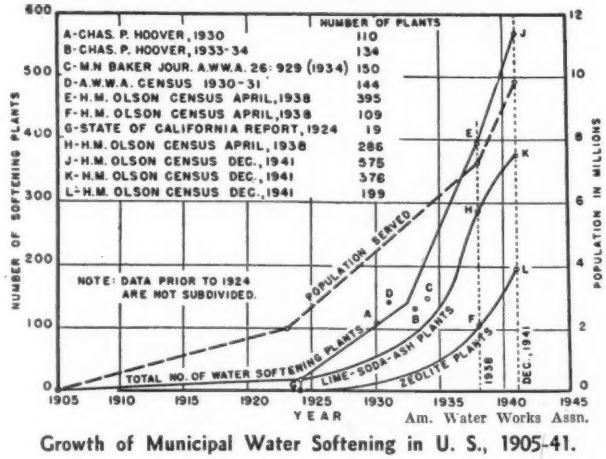
Ozonation At Whiting, Ind.

Whiting draws very polluted water from Lake Michigan, and formerly purified it by aeration, alum coagulation, pre-chlorination, sedimentation, filtration and post-chlorination. In July 1940 the ozone process was installed as a substitute for the aeration. Comparing results in the winter of 1939-1940 without and in 1940-1941 with ozonation, showed threshold odor reduced 58% in the former period and 83% in the latter. Ozone so reduced the chloride demand of the raw water that generally only enough chlorine and ammonia are needed to maintain a desirable residual. In 1940-1941 the cost of alum was reduced 18% below that for 1939-1940, cost of chlorine 33%, and of ammonia 51%. Total cost of chemicals per million gallons in 1939-1940 was $3.50; of chemicals and ozone in 1940-1941, $5.49; net cost of ozone, $1.99. A12*

Softening Statistics

Data have been compiled concerning 575 softening plants in the United States. Of these, 66 serve more than one community, and the total number of communities served approximates 800, and the total population 9,900,000. Only one plant is recorded in the New England states—Winchester, Mass. In the North Atlantic states the number is 57; in the Central states, 250; in the Southern states east of the Mississippi, 70; Pacific Coast states, 11; balance of the states west of the Mississippi, 186. Classifying the plants by size of population served, 147 serve populations under 1,000; 240, population between 1,000 and 5,000; 78, between 5,000 and 10,000; 56, between 10,000 and 20,000; 31, between 20,000 and 50,000; 22, between 50,000 and 1,0000,000; and 1 over 1,000,000.

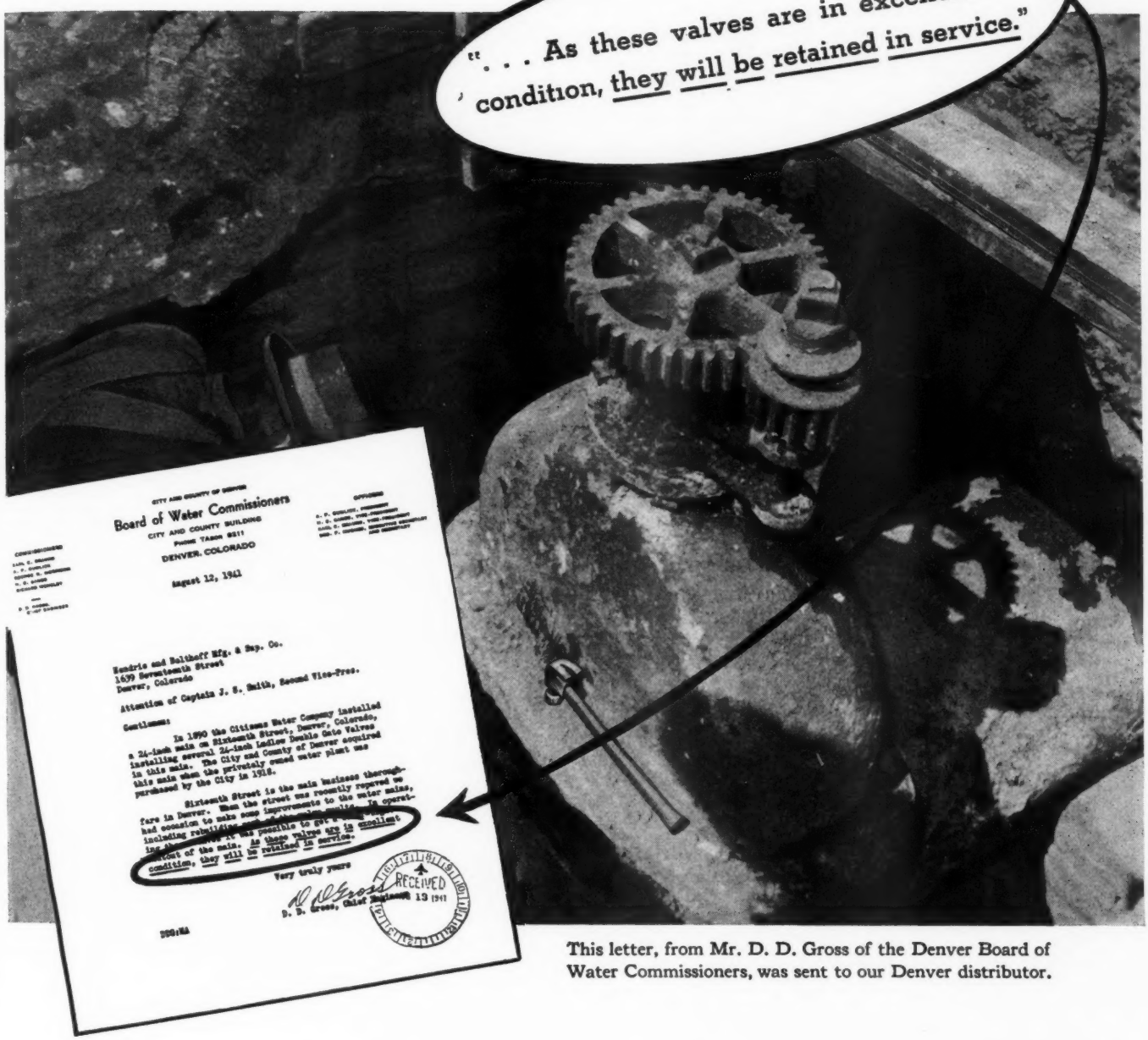
Of the waters softened, 368 are from wells, 133 from rivers and streams, 58, impounding reservoirs; 18, springs, and 3 are mine waters. Zeolite plants are used in 199 cases and chemical precipitation in 377. (One city uses both.) In a few cases the hardness of the raw water is below 100 ppm, some range around 1,000 ppm, but the great majority are between 200 ppm and 500 ppm. In most cases the hardness of the tap water ranges from well below 100 to less than 200; 50 ppm—40 ppm in some cases—is considered the proper goal with proper pH control. A16


NUMBER OF PLANTS
A-CHAS. P. HOOVER, 1930 110
B-CHAS. P. HOOVER, 1933-34 134
C-M.N BAKER JOUR. A.W.W.A. 26: 929 (1934) 150
D-A.W.W.A. CENSUS 1930-31 144
E-H.M. OLSON CENSUS APRIL, 1938 395
F-H.M. OLSON CENSUS APRIL, 1938 109
G-STATE OF CALIFORNIA REPORT, 1924 19
H-H.M. OLSON CENSUS APRIL, 1938 286
J-H.M. OLSON CENSUS DEC., 1941 575
K-H.M. OLSON CENSUS DEC., 1941 576
L-H.M. OLSON CENSUS DEC., 1941 199
NOTE: DATA PRIOR TO 1924 ARE NOT SUBDIVIDED.
POPULATION SERVED
TOTAL NO. OF WATER SOFTENING PLANTS
LIME-SODA-ASH PLANTS
ZEOLITE PLANTS
DEC., 1941
NUMBER OF SOFTENING PLANTS
POPULATION IN MILLIONS
YEAR
Am. Water Works Assn.

Growth of Municipal Water Softening in U. S., 1905-41.

*See Bibliography in the January issue.

After 51 years . . .


". . . As these valves are in excellent condition, they will be retained in service."
Board of Water Commissioners
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Gentlemen:
In 1890 the Citizens Water Company installed a 24-inch main on Sixteenth Street, Denver, Colorado, installing several 24-inch Ludlow Double Gate Valves in this main. The City and County of Denver acquired this main when the privately owned water plant was purchased by the City in 1918.
Sixteenth Street is the main business thoroughfare in Denver. When the street was recently repaved we had occasion to make some improvements to the water mains, including relaying [illegible] in operating the [illegible] possible to get [illegible] out of the main. As these valves are in excellent condition, they will be retained in service.
Very truly yours
D. D. Gross, Chief Engineer
RECEIVED
1941

This letter, from Mr. D. D. Gross of the Denver Board of Water Commissioners, was sent to our Denver distributor.

In the year 1890, a number of Ludlow Valves were installed in a 24" water main under Sixteenth Street, Denver, Colorado.

In 1941, the valve vaults were opened and the valves tested. They were *found to give watertight shut-off of the main.* Since the valves are still in excellent condition, "they will be retained in service."

Longer life and low maintenance costs are only two of the reasons why many water works departments standardize on Ludlow Valves. In addition, the double-disc parallel seat principle which Ludlow developed and perfected assures easy operation at all times, positive closure and self-cleaning seats. Send for catalog No. 201 which fully describes Ludlow Valves and Hydrants.

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When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 55-57

Dechlorination With Granular Carbon

Granular active carbon in filters is recommended for dechlorination after superchlorination. Two beds of 0.4 mesh 42″ deep in pressure filters in Chicago were practically as effective in 1939 as when installed in 1934. This carbon also removes tastes and odors, but where these are severe it would require uneconomically large beds to effect complete removal, and the water might better be dosed with sufficient powdered carbon to reduce the taste to approximate palatability and complete removal be effected by means of a carbon filter. This practice is especially desirable where excessive tastes occur only occasionally. Carbon beds should be kept sterile.[U1]

Chlorine-Ammonia Treatment—A Review

It is doubtful if adding chlorine and ammonia separately produces true chloramines; but a combination is formed having properties similar to those of true chloramines. This treatment reduces phenolic tastes and algae growths, inhibits or destroys iron bacteria, and has a disinfecting effect equal or superior to that of chlorine alone, but two hours contact period is necessary for statisfactory results. The killing velocity decreases with a decrease in temperature and with increase of pH. Efficiency in turbid waters is superior to that of chlorine alone. Cost of chemicals is higher than for chlorine treatment, but cost of plant operation may be less and disinfection more effective.

Aeration of ammonia-chlorinated water seems to have no effect on residuals up to 0.5 ppm, but to reduce 1.75 ppm by as much as 50%.

The Committee on Chlorine-Ammonia Treatment recommended that the proper application of the treatment be considered an effective means for disinfecting waters where chlorinous tastes and odors must be limited, and for maintaining residual chlorine values in distribution systems and other parts of a water supply; that it be adopted for a given supply only after complete investigation of its efficacy under existing local conditions, and be carefully controlled and residuals maintained not less than twice those found effective with chlorine alone, and that minimum period of contact for two hours be provided. To obtain rapid disinfection when the production of taste and odor is not a factor, chlorine should be added in advance of the ammonia and only sufficient ammonia be used to react with the chlorine to maintain adequate residual chlorine concentrations in the distribution system. The ortho-tolidine test should be used to measure chloramine residuals, following the same technique established for the measurement of chlorine residuals.[A14]

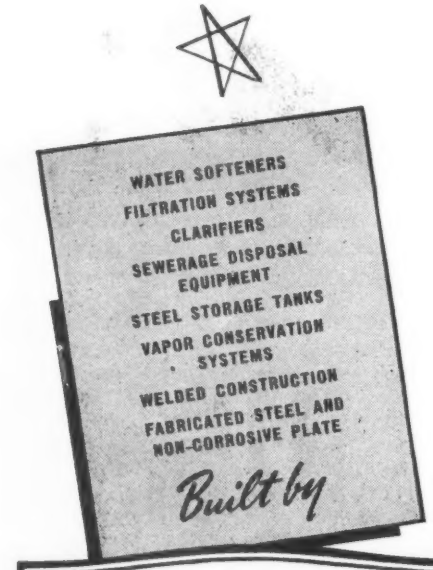
Plankton Control by Chemicals

Tests at Indianapolis indicated that copper sulfate is more generally effective than chlorine as an algicide; that its solubility in hard water is not improved materially by chlorine or ammonia. Ammonium sulfate appears to be more suitable for use with chlorine when copper sulfate is a part of the treatment. Copper sulfate added to an alkaline water in dilute solution is mixed more thoroughly before precipitation than when a strong solution is used. If chlorine is used it is better to feed it with or before the copper solution to reduce the pH value and permit greater dilution before addition to the water to be treated.[A14]

Protecting Reservoir Wall Against Ice

The vertical concrete walls lining a reservoir at Auburn, Me., were pushed out at the top by ice each winter, forming horizontal cracks and leaks. This was prevented last winter by placing a boom of logs 3 ft. from the walls all around. These formed a sort of joint in the ice, which would rise along the boom under ice pressure and prevented a direct push against the walls; and no leakage occurred this spring.[G6]

First Line Of Defense For Public Health



EVERY community in the country is affected in some way by the National Defense Program. Manufacturing production is up. Factories are working twenty-four hours a day. In many instances populations have doubled almost overnight. The housing shortage is acute. And, as a result, the demands on the local water supply have multiplied in proportion.

In the light of this situation it is apparent that, in many instances, existing equipment, which for years has supplied normal needs, can no longer be depended upon to deliver pure water in sufficient volume. Yet public health must be safeguarded at all costs. It is our first line of defense. And an adequate supply of properly conditioned water to meet emergency demands is imperative.

Graver has specialized in the design and manufacture of all types of water conditioning equipment for more than thirty years. In the interests of National Defense you should check over your equipment today. Make certain that your facilities are adequate, efficient, and economical. And if you are confronted with any water treating problem, consult Graver at once. Our engineers will gladly make an analysis of water samples and submit unbiased recommendations.

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Removing Iron by Filtration

The Sanford, Me., Water District obtains its supply from wells 20 to 30 ft. deep. This has an average iron content of 1.0 to 1.5 ppm and CO_2 of 20 to 30 ppm. Zeolite type pressure filters installed in 1936, with 24″ of zeolite on 12″ of gravel removed the iron satisfactorily, but it was difficult to maintain the pH of the raw water sufficiently high to prevent disintegration of the zeolite. Either soda ash, sodium silicate or caustic soda raised the pH but interfered with the iron-removing action of the zeolite. After a year's experimenting using a roughing filter of coarse sand followed by either a zeolite filter or one of fine sand preceded by aeration, it was found that the latter gave as good results as either manganese zeolite or sodium zeolite, and it was adopted in 1940, using 8″ of gravel, 10″ of coarse sand and 12″ of fine sand. More wash water is needed than with zeolite. After a year's operation the sand is quite heavily coated with iron but is still serviceable. The effluent has practically zero iron content.[G1*]

Bibliography of Waterworks Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

A *Journal, American Water Works Ass'n.*
December

14. Chlorine-Ammonia Treatment of Water. Committee Report. Pp. 2079-2123.
15. History of Taste and Odor Control. By W. W. Hassler. Pp. 2124-2152.
16. Census of U. S. Municipal Water Softening Plants. By H. W. Olson. Pp. 2153-2191.
17. Machinery Breakdown Insurance. By A. F. Graham. Pp. 2192-2200.
18. Billing Procedure for a Group of Small Plants. By W. H. Ogden. Pp. 2201-2206.
19. Depth Sampler. Pp. 2207-2209.
20. Comments on Committee Report A 9. Pp. 2210-2214.
21. Revising the U. S. Standards for Drinking Water Quality. Discussions by A. Wolman, J. K. Hoskins, A. M. Buswell, A. A. Hirsch, L. C. Billings, E. S. Chase and R. E. Noble. Pp. 2215-2226.

E *Engineering News-Record*
January 1

2. c. Grouting Tunnel Lining on the Aqueduct. Pp. 39-41.
3. Chart For Balancing Pipe Head Losses by the Hardy Cross Method. By G. M. Slight. Pp. 61-62.

F *Water Works Engineering*
December 31

5. Filter Plant Operating Results (Biddeford, Me.) By N. N. Wolpert. Pp. 1602-1604.
6. Treating Water at Fergus Falls. By J. E. Young. Pp. 1605-1607.
7. Main Crossing Harbor Placed by Department. By H. J. Draves. Pp. 1611-1612.

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8. Emergency Reservoirs for Wartime Fire Fighting. By R. Perera. Pp. 16-19.
9. Automatic Station Control. By G. C. Boyer. Pp. 20-22.
10. Removing and Purging Well Screens. Pp. 25-26.
11. Lucite Pipes Make Visible Water Flows in Model Tests. Pp. 31-32, 47.
12. Pipe Corrosion Problems in Apartment Buildings. By H. L. Shuldener. Pp. 32-33, 48-50.

G *Water Works & Sewerage*
December

4. Lime Softening Graphically Studied. By H. O. Hartung. Pp. 539-544.
5. Some Pertinent Facts on Residential Meters. By L. V. Trentlage. Pp. 545-548.
6. Protecting a Reservoir Against Ice. By H. J. Cook. P. 549.
7. Locating and Stopping a Leak in a Water Works Dam. By H. L. Field and C. I. Sterling, Jr. Pp. 553-554.

J *American City*
January

4. Pump Protection From Bombing. Pp. 68-70.
5. Wire Fence Protects Washington Water Supply. P. 71.

K *Proceedings, Am. Soc. of Civil Engineers*
January

1. Protective and Remedial Measures for Sanitary and Public Health Engineering Services. Committee Report. Pp. 105-135.

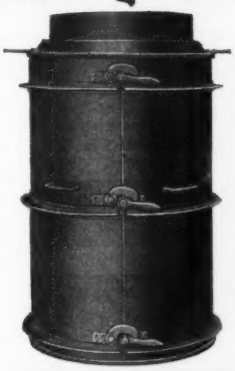
P *Public Works*
January

6. Toledo Dedicates a Fine New Water Works. Pp. 13-15, 39-41.
7. Tank Design to Resist Seismic Force. P. 18.
8. Tunnels for Increasing Honolulu's Artesian Water Supply. P. 29.
9. Wartime Protection of Water Supply Systems. By J. D. Lewin and M. J. Popper. Pp. 30, 32-34.

U *Taste and Odor Control*
November

1. The Importance of Granular Carbon in Municipal and Industrial Water Plants. By J. P. Harris. Pp. 1-6.

The "Quinn Standard"
FOR CONCRETE PIPE



The Quinn Standard is known as the best the world over, wherever concrete pipe is produced and used. Backed by over 30 years service in the hands of hundreds of Quinn-educated contractors, municipal departments and pipe manufacturers who know from experience that **Quinn pipe forms** and **Quinn mixing formulas** combine to produce the finest concrete pipe at lowest cost.

Quinn Heavy Duty Pipe Forms
Hand or wet process. Built to give more years of service—sizes for any diameter pipe from 12 to 84 inches—tongue and groove or bell end pipe—any length.

Quinn Medium Duty Pipe Forms
For making pipe 12 to 60 inches in diameter—any length.

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Complete information, prices and estimates sent on request.

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HI-SPEED TRAILER TOOL BOXES
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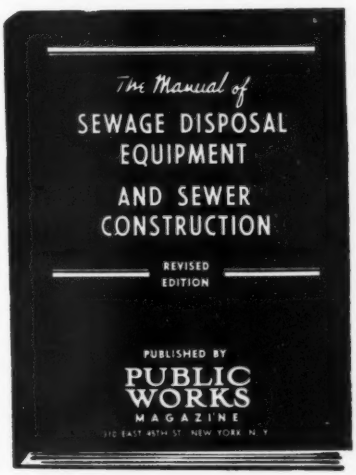
FRANKFORT NEW YORK

1941 EDITION

"A GREAT HELP WHEN WORKING UP DATA ON SEWAGE DISPOSAL"—



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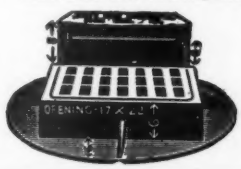
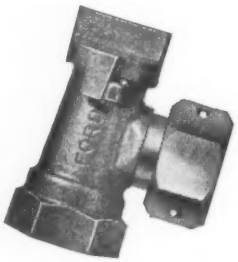
STREET, SEWER AND WATER CASTINGS
Made from wear-resisting chilled iron in various styles, sizes and weights.



MANHOLE COVERS, WATER METER COVERS, ADJUSTABLE CURB INLETS, GUTTER CROSSING PLATES, VALVE AND LAMPHOLE COVERS
Write for Catalog and Prices
SOUTH BEND FOUNDRY CO.
Gray Iron and Semi-Steel Castings
SOUTH BEND, IND.

Ringstyle VALVES

These are quality angle valves of the inverted key type with coupling nuts to attach direct to water meters.



RINGSTYLE Valves are made for connecting to iron or copper pipe. They save meter couplings, joints and space. Learn more about these useful fittings, —ask for our catalog and a sample RINGSTYLE Valve.

FORD METER BOX CO., WABASH, IND.

Keeping Up With New Equipment

Waterproofing Agent for Paving Aggregates

Kotal Company
52 Vanderbilt Ave., New York, N. Y.

Kotal Company, headed by Howard B. Bishop of Summit, New Jersey, has acquired the business heretofore conducted by the Asphalt Treatment Corporation. The product is a waterproofing agent for use on aggregates employed in asphalt highway construction and maintenance.

Associated with Mr. Bishop in the management are Herbert P. Pearson, in charge of Production and Research, the same positions he held in the Asphalt Treatment Corporation, and Charles H. Welling as General Manager of the Company.

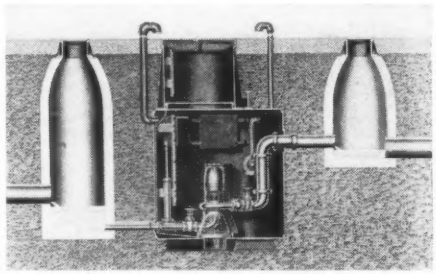
Waterstop Expansion Joint

Servicised Products Corp.
6051 W. 65 St., Chicago, Ill.

Specially designed by Servicised for construction requirements, these Water-Tight Expansion Joints are strongly recommended by the manufacturer for concrete pavement, dams, swimming pools, basement walls and floors, in fact wherever water is a detriment.

Regardless of extreme expansion or contraction of concrete slabs, it is said the product maintains its grip and resiliency indefinitely.

Servicised Expansion Joints are also available in Asphalt, Fiber, Cork, Cork Rubber, Sponge Rubber, Self-Expanding Cork and Para-Plastic Compound. The manufacturers invite your inquiry.



A sectional drawing of a Fairbanks-Morse automatic underground pumping station. Check valves are provided in discharge line to prevent back flow through idle pump. The second pump will start automatically when the water is higher than required to start the first. John Rawlings of the Constructing Quartermaster's Office did the engineering for the Fort Thomas project.

Underground Pump Station Selected for Fort Thomas, Ky.

Fairbanks, Morse & Co.
600 So. Michigan Ave., Chicago, Ill.

At this induction center an expansion of housing facilities was necessary and quickly provided, but a part of the new buildings was located on land which is lower than the sewer system and a pumping station was required to avoid open drainage to the river. The pumps installed were Fairbanks-Morse Fig. 6420 all-steel Duplex pressure controlled underground station employing 4" Fig. 5432 pumps and type "QZY," 3 H.P., 1200 RPM motors. Each unit pumps 325 GPM against a 22 TDH.

"VAREC" Builds New Foundry

Vapor Recovery Systems Co.
Compton, Calif.

The furnaces of the new "VAREC" Foundry are now in full operation following the dedication ceremonies recently. In line with the expansion program initiated by Frank V. Long, president of The Vapor Recovery Systems Company, Compton, California, manufacturers of sewage gas control and safety devices, the foundry is the fifth integral unit to be added in recent months. The warehouse, enlarged machine shop, welding and shipping units were completed early in October. All "VAREC" products are now manufactured "under one roof," thus insuring "VAREC" uniformity throughout.

BUILDERS VICTORY VENTURI

Meter and Controllers, installed on many Army and Navy projects, are doing their share in supplying potable water to our boys wherever they are serving "Old Glory."

BUILDERS - PROVIDENCE, INC.
(DIVISION OF BUILDERS IRON FOUNDRY)
PROVIDENCE . . . RHODE ISLAND

Readers' Service Department

These booklets are FREE. Use the coupon below or write the manufacturer direct, mentioning PUBLIC WORKS.

Construction Materials and Equipment

Air Raid Shelters

3. New 8 page booklet pictures and describes a corrugated pipe shelter with gas tight end walls, emergency escape tunnel and other desirable features. Armco Drainage Products Assn., Middletown, Ohio.

Asphaltic Limestone

5. Characteristics, methods of laying, and results with cold lay mixture shipped ready to use. Especially adapted to resurfacing old pavements, sealcoats and airport runways. Alabama Asphaltic Limestone Co., Liberty Nat. Life Bldg., Birmingham, Ala.

Bridges

7. Teco Connectors, a new method of structural engineering, to spread the load on a timber joint more equally over the cross-section of the wood is described in new literature available from Timber Engineering Co., Inc., Dept. BS-2, 1337 Connecticut Ave., Washington, D. C.

8. A new booklet, "Highway Structures of Douglas Fir," gives up-to-date designs and illustrations of various types of Guard Rails, Culverts, Trestles, Truss Bridges, Arch Bridges and Suspension Bridges built with Douglas Fir. This helpful booklet sent on request by the West Coast Lumbermen's Association, 364 Stuart Bldg., Seattle, Wash.

Cement Dispersion

9. "Economics of Cement Dispersion and Pozzolith" tells the complete story of how cement dispersion reduces water required up to 20% and increases workability 150%. Write The Master Builders Co., Cleveland, Ohio, for a copy.

Cold Mix Plants

10. New catalog and prices of Portable Bituminous Mixers in 6 to 14 ft. sizes for resurfacing and maintenance. Issued by The Jaeger Machine Co., 400 Dublin Ave., Columbus, Ohio.

Colprovia

31. New 48-page booklet in five sections explains clearly the effects, advantages and methods of using Calcium Chloride and Portland Cement mixes. Complete and packed with practical information; well illustrated; pocket size. Sent free on request by Solvay Sales Corp., 40 Rector St., New York, N. Y.

Concrete Accelerators

33. Pocket manual of concrete curing with calcium chloride. Complete, handy. Contains useful tables, well illustrated. Write the Columbia Chemical Division, Pittsburgh Plate Glass Co., 30 Rockefeller Plaza, N. Y. C.

Concrete Mixers

44. Catalog and prices of Concrete Mixers, both Tilting and Non-Tilt types, from 3½S to 56S sizes. The Jaeger Machine Company, 400 Dublin Ave., Columbus, Ohio.

Concreting in Winter

47. "Build Straight Through the Cold Weather Season" explains briefly how to obtain satisfactory winter concrete in less time. Write Michigan Alkali Co., Ford Bldg., Detroit, Mich.

Drainage Products

70. Standard corrugated pipe, perforated pipe and MULTI PLATE pipe and arches — for culverts, sewers, subdrains, cattlepasses and other uses are described in a 48-page catalog entitled "ARMCO Drainage Products," issued by the Armco Drainage Products Association, Middletown, Ohio, and its associated member companies. Ask for Catalog No. 12.

71. Modern Culvert Practice — a 72 page book containing valuable data and tables will be sent promptly to anyone interested in drainage by Gohi Culvert Mfrs., Inc., Newport, Ky.

73. "Principles of Design of Airport Drainage" and other articles on airport drainage reprinted from PUBLIC WORKS Magazine are being distributed free by Bowerston Shale Co., Bowerston, O., Hancock Brick & Tile Co., Findlay, O., and Columbus Clay Mfg. Co., Blacklick, O. Address anyone of the above for a copy.

Expansion Joints

84. Flexcell cellular expansion joints that compress without extruding and spring back when released are illustrated and described in a new bulletin prepared by The Celotex Corp., 919 No. Michigan Ave., Chicago, Ill.

Graders, Patrol

105. The Austin-Western 99M Power Grader with its powerful all wheel drive simplifies all construction and maintenance; handles difficult jobs with economy and efficiency; and does better work on grading, ditching, scarifying, snow plowing, loading, mixing, bulldozing, shoulder trenching and backsloping. Write for Bulletin 1946. Austin-Western Road Machinery Co., Aurora, Ill.

Mud-Jack Method

107. How the Mud Jack Method for raising concrete curb, gutter, walls and street solves problems of that kind quickly and economically without the usual cost of time-consuming reconstruction activities — a new bulletin by Koehring Company, 3026 West Concordia Ave., Milwaukee, Wis.

Paving Materials, Bituminous

111. An excellent booklet issued by The Barrett Co., 40 Rector St., New York, N. Y., describes and illustrates the uses of each grade of Tarvia and Tarvialithic; 32 good illustrations.

114. Colprovia Paving Process for non-skid pavements include Plant Mixes by both the Heater and Cold Processes, Road Mix Process and Surface Treatment Process. New literature covering these processes is available from Colprovia Roads, Inc., 183 East Main St., Rochester, N. Y.

Paving Materials, Brick

116. "New Developments in Brick Pavements." A review of the developments in brick pavements in recent years. Issued by the National Paving Brick Association, National Press Building, Washingon, D. C.

Pumps

121. New illustrated catalog and prices of Jaeger Sure Prime Pumps, 2" to 10" sizes, 7000 to 220,000 G.P.H. capacities, also Jetting, Caisson, Road Pumps, recently issued by The Jaeger Machine Company, 400 Dublin Ave., Columbus, Ohio.

123. New brochure by Gorman-Rupp Co., Mansfield, Ohio, illustrates and describes many of the pumps in their complete line. Covers heavy duty and standard duty self-priming centrifugals, jetting pumps, well point pumps, triplex road pumps and the lightweight pumps.

124. 16-page illustrated bulletin, SP-37, describes and illustrates complete C. H. & E. line of self-priming centrifugal pumps from ½" to 8", including lightweight models for easy portability. C. H. & E. Mfg. Co., 3841 No. Palmer St., Milwaukee, Wis.

128. Motor Patrol Graders for road maintenance, road widening and road building, a complete line offering choice of weight, power, final drive and special equipment to exactly fit the job. Action pictures and full details are in catalogs Nos. 253, 254 & 255, issued by Galion Iron Works & Mfg. Co., Galion, Ohio.

129. New bulletins illustrate and describe the latest line of Littleford Utility Spray Tanks, Street Marking Units, Street Flushers and Kettles. Littleford Bros., 452 East Pearl St., Cincinnati, Ohio.

Rollers

133. New Tu-Ton roller of simple construction for use in rolling sidewalks along highways, playgrounds and other types of light rolling is fully described in a bulletin issued by C. H. & E. Mfg. Co., 3841 No. Palmer St., Milwaukee, Wis.

138. "The Buffalo-Springfield line of road rollers (tandem, 3-wheel, and 3-axle) are described in the latest catalog issued by the Buffalo-Springfield Roller Co., Springfield, Ohio."

139. "Ironeroller" 3 Axle Roller for extra smooth surfaces on all bituminous work. Booklet contains roller data and operation details. Hercules Co., Marion, Ohio.

Spreader

147. Jaeger Paving equipment, including Mix-in-Place Roadbuilders, Bituminous Pavers, Concrete Bituminous Finishers, Adjustable Spreaders, Forms, etc.—4 complete catalogs of latest equipment in one cover, issued by The Jaeger Machine Company, 400 Dublin Ave., Columbus, Ohio.

Street and Paving Maintenance

Asphalt Heaters

198. Illustrated Bulletins 15 to 20 describe Mohawk Oil Burning Torches; "Hotstuf" Tar and Asphalt Heaters; Portable Trailer Tool Boxes; Pouring Pots and other equipment for street and highway maintenance, roofing, pipe coating, water proofing, etc. Mohawk Asphalt Heater Co., Frankfort, N. Y.

Snow Fighting

Plows

350. "Frink One-Way Sno-Plows" is a four page catalog illustrating and describing 5 models of One-Way Blade Type Sno-Plows for motor trucks from 1½ up to 8 tons capacity. Interchangeable with V Sno-Plow. Features, specifications and method of attaching. Carl H. Frink, Mfr., Clayton, 1000 Islands, N. Y.

Ice Control

351. "Make Icy Highways Safe for Traffic"—a new bulletin by Michigan Al-

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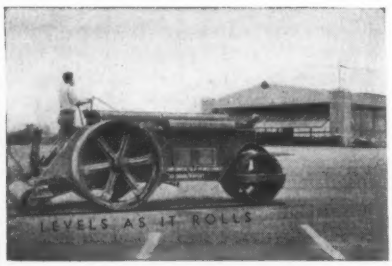

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High spots rolled out first—not afterwards
Lower investment
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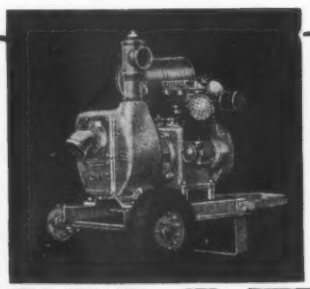

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Self-Priming
Centrifugal Pumps
25 MODELS
A complete line from ½" to 10". Capacities 3000 G.P.H. to 200000 G.P.H. Lightweight models for easy portability. Write for 16 page pump bulletin SPP-40.
Also send for catalogs on SAW RIGS, HOISTS, MORTAR MIXERS, BAR BENDERS and CUTTERS, and TANDEM ROLLERS.
C H & E MANUFACTURING CO.
3841 No. Palmer St., Milwaukee, Wis.

Readers' Service Department

(Continued from page 55)

kali Co., Ford Bldg., Detroit, Mich., tells how to use calcium chloride for modern ice control.

Sanitary Engineering

Activated Alum

354. "Technical Data on Activated Alum and Dustless Blackalum" points out the analytical side of Activated Alum and Blackalum. Write Activated Alum Corp., 516 No. Charles St., Baltimore, Md.

Aero-Filter

356. "Results Produced by Aero-Filters" is a new pamphlet covering results at Temple, Texas; Paris, Ill.; Webster City, Iowa; and Mason, Mich. Write Lakeside Engineering Corp., 222 West Adams St., Chicago, Ill.

Analysis of Water

360. "Methods of Analyzing Water for Municipal and Industrial Use" is an excellent 94 page booklet with many useful tables and formulas. Sent on request by Solvay Sales Corp., 40 Rector St., New York, N. Y.

Activation and Aeration

376. A valuable booklet on porous diffuser plates and tubes for sewage treatment plants. Covers permeability, porosity, pore size and pressure loss data, with curves. Also information on installations, with sketches and pictures, specifications, methods of cleaning and studies in permeability. 20pp. illustrated. Sent on request to Norton Company, Worcester, Mass.

Cleaning Sewers

383. A 20-page booklet describes and illustrates a full line of sewer cleaning equipment—Rods, Root Cutters, Buckets, Nozzles and Flushers. Write W. H. Stewart (Pioneer Mfr. since 1901), Jacksonville, Fla., or P. O. Box 767, Syracuse, N. Y.

384. A new 32-page, illustrated booklet explains how a city can clean its sewers and culverts with its own forces using the up-to-date Flexible Sewer Rod equipment. Illustrates and describes all necessary equipment. Issued by Flexible Sewer Rod Equipment Co., 9059 Venice Boul., Los Angeles, Calif.

Consulting Engineers

385. "Who, What, Why" outlines briefly the functions of the consulting chemist and chemical engineer. Covers various methods of cooperation, on different types of problems, with industry, with attorneys and with individuals. Foster D. Snell, Inc., 305 Washington St., Brooklyn, N. Y., will send a copy on request.

Feeders, Chlorine, Amonia and Chemical

387. For chlorinating water supplies, sewage plants, swimming pools and feeding practically any chemical used in sanitation treatment of water and sewage. Flow of water controls dosage of chemical; reagent feed is immediately adjustable. Starts and stops automatically. Literature from % Proportioneers, Inc. % 96 Codding St., Providence, R. I.

Filter Bed Agitator

388. 60-page booklet, "The Mechanics of Filter Bed Agitation," containing engineering data, technical information concerning surface wash and opinions of users will be sent promptly by Stuart-Brumley Corp., 516 No. Charles St., Baltimore, Md.

Filter Plant Controllers

389. "The Modern Filter Plant" and the uses of Simplex Controllers for operation are described in a handy, 16-page booklet. Charts, data, curves and tables. Simplex Valve and Meter Co., 6750 Upland St., Philadelphia, Pa.

Fire Hydrants

390. Specifications for standard AWWA fire hydrants with helpful instructions for ordering, installing, repairing, lengthening and using. Issued by M. & H. Valve & Fittings Co., Anniston, Ala.

391. See listing No. 410.

Gates, Valves, Hydrants

394. Gate, flap and check valves; floor stands and fittings. New catalog No. 34 gives detail information with dimensions for all types of new full line. M. & H. Valve & Fittings Co., Anniston, Ala.

395. Complete booklet with much worthwhile water works data describes fully Ludlow hydrants and valves. Sent on request. Ludlow Valve Mfg. Co., Troy, N. Y.

396. See listing No. 410.

Hypochlorinators

400. New illustrated booklet W&T 357 describes this simple, inexpensive means of protecting small water supplies such as summer camps, hotels, swimming pools, dairies, etc., as well as for feeding chemical solutions in the water works plant. Contains typical installation sketches. Write "Wallace & Tiernan Co., Inc., Newark, N. J.

Manhole Covers and Inlets

402. Street, sewer and water castings in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog issued by South Bend Foundry Co., Lafayette Boul. and Indiana Ave., South Bend, Ind.

Meters, Venturi

405. MS Meters for use with venturi tubes, flow nozzles, etc., in wall, panel, or floor mounting are covered in detail in catalog sent free by Simplex Valve & Meter Co., 6750 Upland St., Philadelphia, Pa.

406. New bulletin illustrates Builders Air Relay system of transmission for the Venturi Meter which is particularly useful for liquids containing suspended solids like sewage. Eliminates corroson, clogged pipes, etc. Write Builders Iron Foundry, Codding St., Providence, R. I.

Pipe, Cast Iron

408. Handbook of Universal Cast Iron Pipe and Fittings, pocket size, 104 pages, illustrated, including 14 pages of useful reference tables and data. Sent by The Central Foundry Co., 386 Fourth Ave., New York, N. Y.

409. Cast iron pipe and fittings for water, gas, sewer and industrial service. Super-deLavaud centrifugally-cast and pit-cast pipe. Bell-and-spigot, U. S. Joint, flanged or flexible joints can be furnished to suit requirements. Write U. S. Pipe and Foundry Co., Burlington, N. J.

410. "Cast Iron Pipe and Fittings" is a well illustrated 44 page catalog giving full specifications for their complete line of Sand Spun Centrifugal Pipe, Fire Hydrants, Gate Valves, Special Castings, etc. Will be sent promptly by R. D. Wood Co., 400 Chestnut St., Philadelphia, Pa.

Pipe Forms

411. Making concrete pipe on the job to give employment at home is the subject of a new booklet just issued by Quinn Wire and Iron Works, 1621 Twelfth St., Boone, Ia., manufacturers of "Heavy Duty" Pipe Forms. Sent promptly on request.

Pipe, Reinforced Concrete

412. Literature describing the manufacture and installaton of Lock Joint Reinforced Concrete Pressure Pipe for water supply lines and sewer force mains. Lock Joint Pipe Co., Ampere, N. J.

Pipe Repair Materials

413. Repair clamps and saddles for steel and cast iron pipe; pipe line clamps; pipe joint clamps and many other handy and economical tools for the water works man. Catalog 41. M. B. Skinner Company, South Bend, Ind.

Pipe, Transite

414. Two new illustrated booklets, "Tansite Pressure Pipe" and "Transite Sewer Pipe" deal with methods of cutting costs of installation and maintenance of pipe lines and summarize advantages resulting from use of Transite pipes. Sent promptly by Johns-Manville Corp., 22 East 40th St., New York, N. Y.

Pipe Joints, Sewer

415. How to make a perfect sewer pipe joint—tight, prevents roots entering sewer, keeps lengths perfectly aligned; can be laid with water in trench or pipe. General instructions issued by L. A. Weston, Adams, Mass.

Pumps and Well Water Systems

420. Installation views and sectional scenes on Layne Vertical Centrifugal and Vertical Turbine Pumps fully illustrated and including useful engineering data section. Layne Shutter Screens for Gravel Wall Wells. Write for descriptive booklets. Advertising Dept., Layne & Bowler, Inc., Box 186, Hollywood Station, Memphis, Tenn.

Meter Setting and Testing

430. The most complete catalog we have seen on setting and testing equipment for water meters—exquisitely printed and illustrated 48-page booklet you should have a copy of. Ask Ford Meter Box Co., Wabash, Ind.

Sand Expansion Indicator

432. New bulletin gives full details of Simplex Sand Expansion Indicators for water plants. Write Simplex Valve & Meter Co., 6750 Upland St., Philadelphia, Pa.

434. Be assured of uninterrupted, constant automatic removal of screenings. Folder 1587 tells how. Gives some of the outstanding advantages of "Straightline Bar Screens" (Vertical and Inclined types). Link-Belt Co., 307 N. Michigan Ave., Chicago, Ill.

Sewers

437. "ARMCO Sewers" is the title of a 48-page booklet describing the structural and other advantages of ARMCO Ingot Iron. Paved Invert and Asbestos-Bonded pipe for storm and sanitary sewers. Design data and large charts will be found helpful by engineers engaged in the design or construction of sewers. Copies will be sent on request by the Armco Drainage Products Association, Middletown, Ohio, or its associated member companies.

Sludge Drying and Incineration

440. "Disposal of Municipal Refuse." Complete specifications and description including suggested form of proposal; form of guarantees; statements and approval sheet for comparing bids with diagramatic outline of various plant designs. 48 pages. Address: Morse Boulger Destructor Co., 216-P East 45th St., New York, N. Y.

442. Recuperator tubes made from Silicon Carbide and "Fireclay" Corebusters for maximum efficiency are described and illustrated in bulletin No. 11 issued by Fitch Recuperator Co., Plainfield National Bank Bldg., Plainfield, N. J.

Softening

444. This folder explains the process of Zeolite water softening and describes and illustrates the full line of equipment for that purpose made by the Graver Tank & Mfg. Co., 4809-15 Tod Ave., East Chicago, Ill. Write for a copy of this instructive folder.

Swimming Pools

446. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

447. 40-page Manual on swimming pools. Includes swimming and pool layouts, specifications, etc., and details concerning Permutit Swimming Pool Equipment. Write The Permutit Co., Dept. G-4, 330 West 42 St., New York, N. Y.

Taste and Odor Control

450. Technical pub. No. 207 issued by Wallace & Tiernan Co., Inc., Newark, N. J., describes in detail taste and odor control of water with BREAK-POINT Chlorination, a method of discovering the point at which many causes of taste may be removed by chlorination with little or no increase in residual chlorine. Sent free to any operator requesting it.

Treatment

453. "Safe Sanitation for a Nation," an interesting booklet containing thumbnail descriptions of the different pieces of P.F.T. equipment for sewage treatment. Includes photos of various installations and complete list of literature available from this company. Write Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago, Ill.

455. New booklet (No. 1642 on Link-Belt Circuline Collectors for Settling Tanks contains excellent pictures; drawings of installations, sanitary engineering data and design details. Link-Belt Company, 2045 W. Hunting Park Ave., Philadelphia.

456. New 16-page illustrated catalog No. 1742 on Straightline Collectors for the efficient, continuous removal of sludge from rectangular tanks at sewarage and water plants. Contains layout drawings, installation pictures, and capacity tables. Address Link-Belt Co., 2045 West Hunting Park Ave., Philadelphia, Pa.

457. New illustrated folder (1942) on Straightline apparatus for the removal and washing of grit and detritus from rectangular grit chambers. Address: Link-Belt Co., 2045 W. Hunting Park Ave., Philadelphia, Pa.

458. "Sedimentation with Dorr Clarifiers" is a complete 36-page illustrated catalog with useful design data. Ask The Dorr Company, 570 Lexington Ave., New York, N. Y.

459. A combination mechanical clarifier and mechanical digester, The Dorr Clarigester, is explained and illustrated in a bulletin issued by The Dorr Company, 570 Lexington Ave., New York, N. Y.

461. Preflocculation without chemicals with the Dorrco Clariflocculator in a single structure is the subject of a new booklet issued by The Dorr Company, 570 Lexington Ave., New York, N. Y.

462. Dorrco Monorake for existing rectangular sedimentation tanks, open or closed, is described and illustrated in a new catalog sent on request. The Dorr Co., 570 Lexington Ave., New York, N. Y.

Tunnel Liners

480. "Save Money with Armco *Light Duty* Tunnel Liner" is a bulletin you'll want if you are interested in economical, long lasting tunnels. Write Armco Drainage Products Assn., Middletown, Ohio.

Valves (See Gates, Air Release, etc.)

Water Works Operating Practices

490. "Important Factors in Coagulation" is an excellent review with bibliography and outlines of latest work done in the field. Written by Burton W. Graham and sent free on request to Activated Alum Corp., 516 No. Charles St., Baltimore, Md.

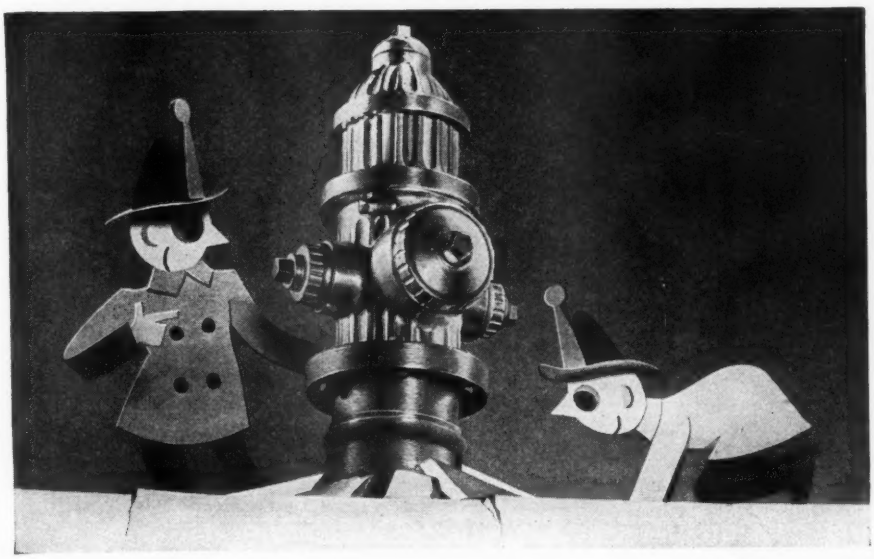
Water Service Devices

500. Data on anti-freeze outdoor drinking fountains, hydrants, street washers, etc., will be sent promptly on request to Murdock Mfg. & Supply Co., 426 Plum St., Cincinnati, Ohio.

Rassweiler Vice President Johns-Manville Corp.

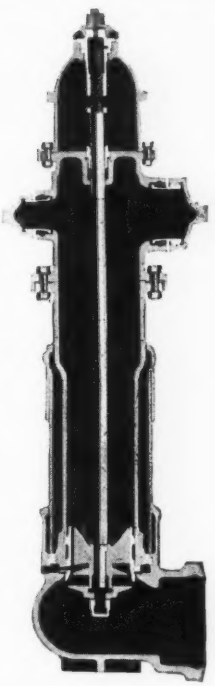
Dr. C. F. Rassweiler, who joined Johns-Manville last June as director of research, has been appointed a vice president of Johns-Manville Corporation.

In his new office, Dr. Rassweiler will continue in charge of the company's research and development activities which are not largely devoted to converting the full production capacity of Johns-Manville to war uses. Intensive studies of new products and entirely new business possibilities for J-M which may be introduced to create additional employment and sales after the war is over, are also being conducted.



28" OF FROST IN THE GROUND BUT OUR MATHEWS NEVER BUDGED

Everybody knows that ground swells when it freezes. But Mathews is the only hydrant designed to prevent that swelling ground from heaving the hydrant loose from its water main. The Mathews Hydrant has a loose protection case which is free to rise and fall without putting any strain on water carrying parts. If you face cracked or leaky hydrants this spring, investigate Mathews. This same protection case allows the barrel, containing all working parts, to be changed like a spare tire for repair, overhaul, or modernization.



MATHEWS HYDRANTS

Made by R.D. WOOD Company

400 CHESTNUT STREET, PHILADELPHIA, PA.

ESTABLISHED IN 1803

Cats Have 9 Lives

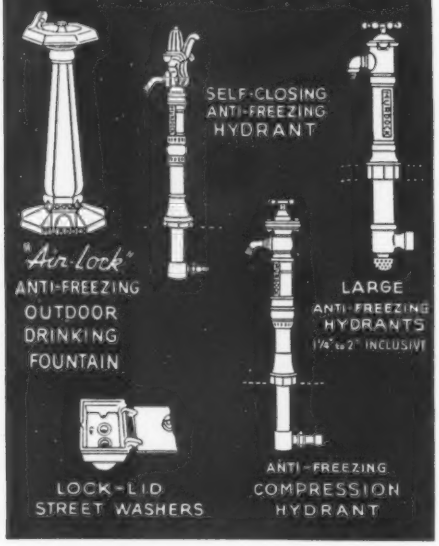
With all their nine lives cats can't outlive Murdock Water Service Devices.

They are built to endure, of materials that defy vandals. They work every day in the year with very little attention.

Specify "Murdock."

THE MURDOCK MFG. & SUP. CO.
426 Plum St. Cincinnati, O.

MURDOCK


SELF-CLOSING ANTI-FREEZING HYDRANT
"Air-Lock" ANTI-FREEZING OUTDOOR DRINKING FOUNTAIN
LARGE ANTI-FREEZING HYDRANTS 1⅛" to 2" INCLUSIVE
LOCK-LID STREET WASHERS
ANTI-FREEZING COMPRESSION HYDRANT

"Hypochlorites soon to disappear from Market."
—SAYS RUMOR

but don't let them fool you,

and don't take *our* word that hypo is available. *Get the TRUTH* from manufacturers of both Calcium and Sodium hypochlorites or from Priorities Chemicals Division. *Remember*—there are *three* forms of Chlorine available for water and sewage treatment,

not only (1) Chlorine gas
or . . . (2) Dry Calcium Hypochlorite Powder (HTH or Perchloron)
but also (3) Hypochlorite liquids (Sodium or Calcium)

All three are covered by Preference Rating Order M-19, and *all* carry a priority of A-2 when used for public health protection. There are no more stringent restrictions on hypochlorite liquid than there are on gas.

Ask Mathieson Alkali Co. for up-to-date information on HTH. Ask Pennsylvania Salt Co. for information on Perchloron. Ask any of the hundreds of manufacturers of Sodium Hypochlorite in the form of soda bleach or bleach water such as Klenzade, Chlorox, Wilchlor, Merchlor, etc., all over the country, for information on their product. — There's a hypo-producer within shipping distance of every state in the U. S. A. Then if you *still* worry about shortage, ask the Priorities Chemicals Division.

%Proportioneers, Inc.% will help you locate sources for your needs of hypo. Regardless of rumor, *no water or sewage treatment plant, public or institutional swimming pool need be without protection.*

%PROPORTIONEERS, INC.%
"Chemical Feeder Headquarters"
96 Codding St. Providence, L. I.

PEOPLE *Here and There*

Fleming Now Federal Works Administrator

Brigadier General Philip B. Fleming, formerly Administrator of the Wage and Hour Division, U. S. Department of Labor, has been appointed Federal Works Administrator. His predecessor, John M. Carmody, has been transferred to the U. S. Maritime Commission.

One of Gen. Fleming's first acts was to dispatch speed-up orders to all Regional Directors. He specified the importance of building defense roads and housing, which are war measures.

Flood Made Member of Firm

Frank L. Flood, associated with Metcalf and Eddy since 1925, has been made a member of the firm. Mr. Flood is a member of the American Society of Civil Engineers, New England Water Works Association and New England Sewage Works Assn.

Snell Adds to Staff

Recent additions to the staff of Foster D. Snell, Inc.: Pat Macaluso, B.S., College of the City of New York; Edgar W. Goth, B.A., Grinzing College, Vienna, CH.E., Technical University of Vienna; Peter A. Pfeiffer, B.S., Wesleyan University; Herbert H. Watjen, B.A., Brooklyn College, B.Ch.E., Polytechnic Institute of Brooklyn.

The following appointments were recently reported:

City Engineers

S. R. Wilhoit, Bloomington, Ill.
Walter C. Hogenson, Moorhead, Minn.
Walter M. Schirra, Oradell, N. J.
R. A. Nadeau, Ambridge, Pa.
Frank L. Gardner, Lebanon, Pa.
Walter Smith, Wheeling, W. Va.

City Managers

A. J. Koenig, Jackson, Mich.

Supt. Public Works

J. P. Davini, Winchendon, Mass.

Water Works Superintendents

Robert Diesness, Park Ridge, Ill.
C. H. Bremer, Charles City, Iowa.
E. E. Patrick, Dillon, Mont.
J. L. Merrill, Franklin, N. H.
Albert Wagner, Gibsonburg, Ohio.
Geo. V. Gould, Sidney, Ohio.
R. G. Sphar, Monessen, Pa.
W. A. Van Atta, Vancouver, Wash.

County Engineers

Robert Lathrop, Edwards Co., Albion, Ill.
W. G. Bester, Union Co., Creston, Iowa.
Vernon Miller, Humboldt Co., Indianola, Iowa.
Thos Chastain, Warren Co., McMinnville, Tenn.

Annual Meetings Announced

Association of Highway Officials of North Atlantic States in Benjamin Franklin Hotel, Philadelphia, Pa., Feb. 25-27. American Road Builders' Assn. at Peabody Hotel, Memphis, Tenn., March 2-4. American Public Works Assn. in Cleveland, O., Oct. 12-14.

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